MARCH 6, 1961

American Machinist / Metalworking Manufacturing

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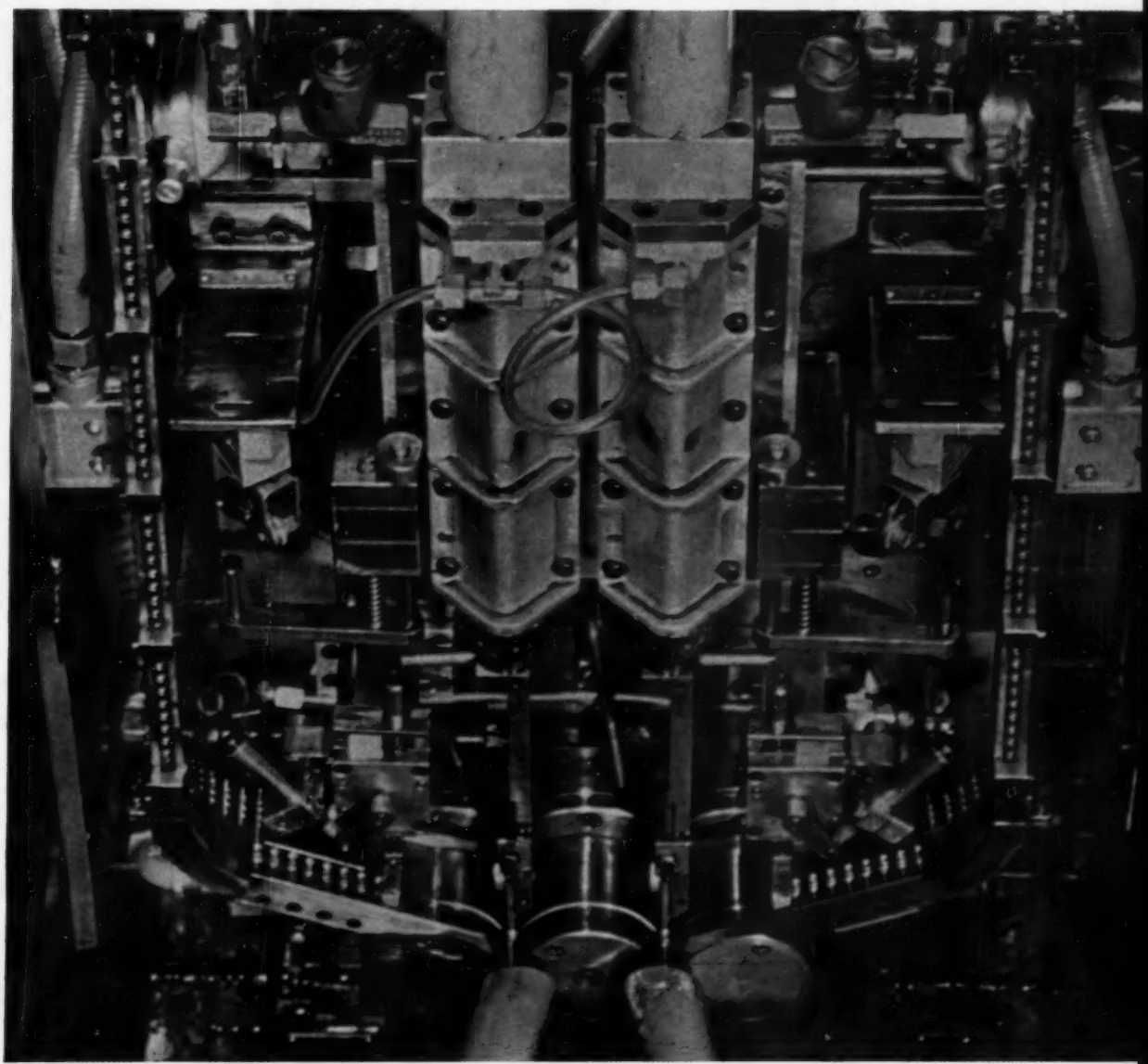

Finishing speedometer cable couplings two at a time—see page 111

- **How to spot flaws in your incentive plan,** p69
- **Precision tapping by electrical discharge,** p72
- **Five ways to chuck flat parts,** p83

TOOL-TIP GEOMETRY...

Elliptical or true Radius?

by Bruno A. Holmstrom
Chief Tool Engineer
The Heald Machine Company

To view this subject in its proper perspective, it is important to remember that no matter how large, complex or costly a boring or turning machine may be, it's the *tool tip* that does the work of removing metal. And on the proper geometry of this small but all-important part depends the success or failure of the entire machining operation.

One of the essentials of good tool design is the correct clearance angle between the work and tool at point of contact.

When finish cutting straight or tapered bores or O.D.'s, a varying clearance angle may be used, as all cutting is done with the outer tip of the tool where this angle is at the maximum. Here a conventional elliptical-point tool, where the clearance angle decreases on either side of the outer tip, is entirely satisfactory. Such tools can be accurately sharpened with an axis of tool reciprocation that is parallel to the face of the grinding wheel, as shown in Fig. 1.

However, when contour boring or turning spherical or irregular shapes, an entirely different situation occurs. Here, the point of contact on the tool tip varies from point to point on the workpiece, as shown in Fig. 2. If a conventional elliptical-point tool were used, the radius and clearance angle would vary from point to point on the work contour and optimum tool geometry would occur only at one of these locations.

For contour work, it is therefore preferable to use a true-radius tool tip—in which the clearance angle and radius is the same for any point on the cutting edge. To generate such a tip, the axis of tool reciprocation must be tilted with respect to the face of the grinding wheel, and this angle then becomes the constant clearance angle of the tool. This is shown in Fig. 3.

To permit grinding either *true-radius* or *elliptical-point* tools with maximum precision and economy, we developed the Heald Model 4 Tool Sharpening Machine. It is the *only* machine of its type which offers this choice of tool-tip geometry while providing fully automatic tool reciprocation for uniform and repetitive tool tip accuracy.

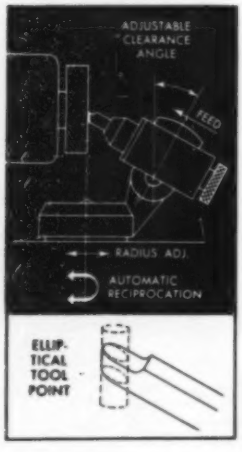

FIG. 1. Elliptical tool point with decreasing clearance angle for conventional straight-line work. Upper sketch shows arrangement of tool sharpening machine.

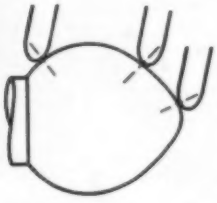

FIG. 2. Sketch showing how contact point of tool varies for different points on a contoured workpiece.

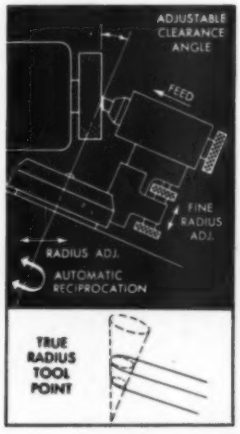

FIG. 3. True-radius tool point with constant clearance angle for contour boring or turning. Upper sketch shows tool sharpening arrangement.

FIG. 4. Heald Model 4 Tool Sharpening Machine arranged for precision grinding of true-radius tool point.

Ask your Heald representative for complete information on the Model 4 Tool Sharpening Machine, or send for Bulletin 2-4-3. It PAYS to come to Heald.

THE HEALD MACHINE COMPANY
Subsidiary of The Cincinnati Milling Machine Co.
WORCESTER 6, MASSACHUSETTS

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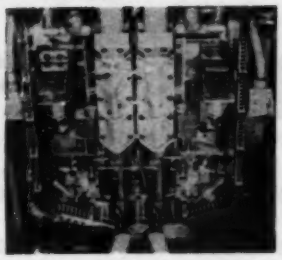
COVER:
Superfinishing machine tooled to handle speedometer cable couplings two at a time. See page 111.



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TURN PAGE FOR METALWORKING REPORT→

METALWORKING REPORT

. . . what's new and significant in manufacturing techniques and materials— direct from our own staff and round-the-world news bureaus

FORMING . . . Double-head electromagnetic swager has 10 times the power of its prototype model (*AM/MM*—Oct 3 '60, p 95), at the Naval Research Laboratory. When a current of 1 million amps is tapped from the 50 kilojoule capacitor bank, **brass ferrules are clamped to both ends of high-inductance cable in 8 microseconds.** (Related story on p 61.) Details of electromagnetic-forming theory, formulas, and several kinds of swaging, forming, drawing, and embossing operations will be published soon.

CUTTING . . . Two new developments in electrical discharge machining bear watching: (1) An EDM tapping head from Portage Tool permits tapping threads with unprecedented accuracy. In the head, **electrode advance is controlled by precision leadscrews.** Details on p 72. (2) In EDM work on narrow slots, **electrode distortion** (caused by heat buildup from trapped gases and eroded metal particles) **has been eliminated.** The secret: **Use a suction pump to flush away gases,** instead of coolant pressure flow. Read about this EDM "first," from Argonne National Laboratory, in the March 6 issue of *AM/MM*.

HEAT TREATING . . . High-temperature, high-vacuum furnace can handle twice its normal work load with only minor structural modifications. The heating chamber—6-in. dia x 7 in. high—easily expands to 12-in. dia x 12 in. high. Electro-Optical Systems Co (Pasadena, Calif) passes 3000-amp current through a tungsten element surrounded by multiple layers of tantalum foil which act as heat shields. **Extreme temperature uniformity even at 2600 C at a vacuum of 10^{-6}** makes it ideal for brazing of refractories.

FORMING . . . Four burner bowls are drawn into cabinet-top range panels by Welbilt Stove Co, Maspeth, NY, without wrinkling the adjacent sheet. By developing dies, upon which a patent application will be made, tooling supervisor Samuel Jacobowitz is **making a "can't-be-done" stamping at 1/3 the cost of conventional range tops** (with separate bowls and trim rings) and at 1/10 the cost of diecasting (which was considered the only practical method with the bowls in place). Job is done in mechanical press.

FINISHING . . . Scratched chrome-plated printing rolls can be repaired in about 25 min right in the shop. Former repair process meant a downtime of about 24 hr for Continental Can Co. With Steel Improvement and Forge Co's Dalic selective plating process, the **damaged area is cleaned,** then the chrome is etched. Next, copper is applied to over-fill the hole. Copper is then **honed flush and given a 0.0001-in. flash of nickel.** Chromium could be used for flash, but nickel flashing is quicker.

MATERIALS HANDLING . . . Magnetic racks can speed handling of large but light metal parts. Called Magna-Rax (Eriez Mfg Co), the devices consist of steel-rod forms (any shape) that have double-ended magnets (any number) spot-welded to them at intervals (any distance). One auto maker uses them, suspended from overhead conveyors, to **convey large body parts for plating and painting.** With their multitude of magnetic holding points, the racks also carry many small parts.

FORMING . . . Supersonic vibration homogenizes molten aluminum in the ingot mold and saves a cent a pound and nearly 7½ hr over furnace homogenization. Commonwealth Extrusion Corp, Bayamon, Puerto Rico, fastens a common air-driven foundry oscillffiator to the ingot mold. **Vibration at 20,000 cpm and amplitude of a few thousandths** gives uniform distribution of alloying elements, improves ductility. Supersonic improvement of ingots has been considered in the US, but has not been adopted, so far as is known.

CUTTING . . . Precision belt grinder has a shoe that lowers into a die or finishes the edges of a punch (as shown in cut). The shoes, available for various sized belts, **can be supplied with curved surfaces.** The arm can be tilted up to five degrees; therefore, since it is connected to a gage, the tool and die shop **now has an accurate way to finish punches with the desired degree of taper.** The grinder easily adapts to templet work. For more details, see the story on p 112.

FINISHING . . . Carbide tool tips are wired to a common shank in groups of eight to prepare them for brazing at Wesson Tool Co. After brazing, the "sticks" are placed in a Pangborn Rotoblast barrel where the **abrasive cuts the wires and blasts apart carbon hold-down and spacing rods.** Cleaned parts are then cut into individual tips.

INSPECTION . . . Rolls up to 12,000 lb and 10 ft long are dynamically balanced in ten to fifteen minutes (including addition of corrective weights, usually by welding) at Wean Mfg Co, Warren, Ohio. Working with International Research and Development Corp, Wean developed a balancer which is said to have **less than half the cost of other available machines.** A 7.5-hp motor gives balancing speeds up to 2000 rpm with an adjustable-speed drive connected by V-belts to main drive spindle.

MANUFACTURING CONTROL . . . Simple tests can uncover flaws in a wage-incentive plan. By analyzing statistics from regular production reports, **management can determine whether workers understand the plan, where standards are too loose or tight,** and many other symptoms of weakness in a wage-incentive plan. For examples of these tests, see the story that starts on p 69.

HEAT TREATING . . . A new process (and machine) straightens and die-quenches transportation equipment side rails up to 40 ft long. A O Smith Corp has combined the new quench technique with intermediate manganese steel to **reduce cost of side members to only 16% more than carbon steel** (vs 69% for SAE 8620 normally used). Because it eliminates hand-straightening operations, process gives lighter side members on a production basis.

Continued on next page

Coming in AM/MM

- *How magnetic forces form metal*
- *Tooling for turret drilling*
- *Pick the right paint*
- *Machinable stainless*

METALWORKING REPORT . . .

MATERIALS . . . Improve electroplating of iron-powder parts by giving the parts a "blue oxide" coating, such as that from applying superheated steam. The oxide—which forms a suitable base for copper, nickel, or chromium—is said to close the pores so effectively that **virtually no corrosion occurs under the deposited metallic layer.** Credited to Alta-Ianos Ceptervezo Iroda, of Budapest, the process is patented in Britain.

ASSEMBLY . . . Aluminum clamp virtually supplies a third hand, when C-clamping a round to a flat, and at the same time **eliminates motion usually caused by turning of a threaded spindle.** This clamp, from United Associates, Clearwater, Fla, has a hinged frame and a pressure applying thumbnut. After spindle contacts assembly, and a gripper is engaged, **clamping pressure is applied with no twisting action.**

MATERIALS . . . An epoxy glass-fiber helicopter rotor blade flew for the first time in the US at Bloomfield, Conn. On Jan 25 the Kaman Aircraft Corp flew an H-43 helicopter with the new blade, calling the flight significant. **Glass-plastic blades offer greater fatigue resistance** as well as lowered manufacturing and maintenance costs.

WELDING . . . Plasma gun prepares parts for brazing by spraying them with brazing material. A powered hopper feeds particles in sizes of 5 microns to 100 mesh so that **one pass with the plasma gun will give desired coverage down to 0.001 in.** The non-oxidizing plasma provides its own shielding against atmospheric contamination. Among the advantages: brazing and flux costs are less; entire surface of joint can be covered, according to Avco Research and Advances Development Div, Wilmington, Mass.

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Aluminum Foil Rolls

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24" and 28" Heavy Duty, five lengths traveling table, Plain and Roll	30 hp	G-587-1
36", 44", 50", 60"- seven lengths, traveling wheel-head, Roll only	40 hp	G-700

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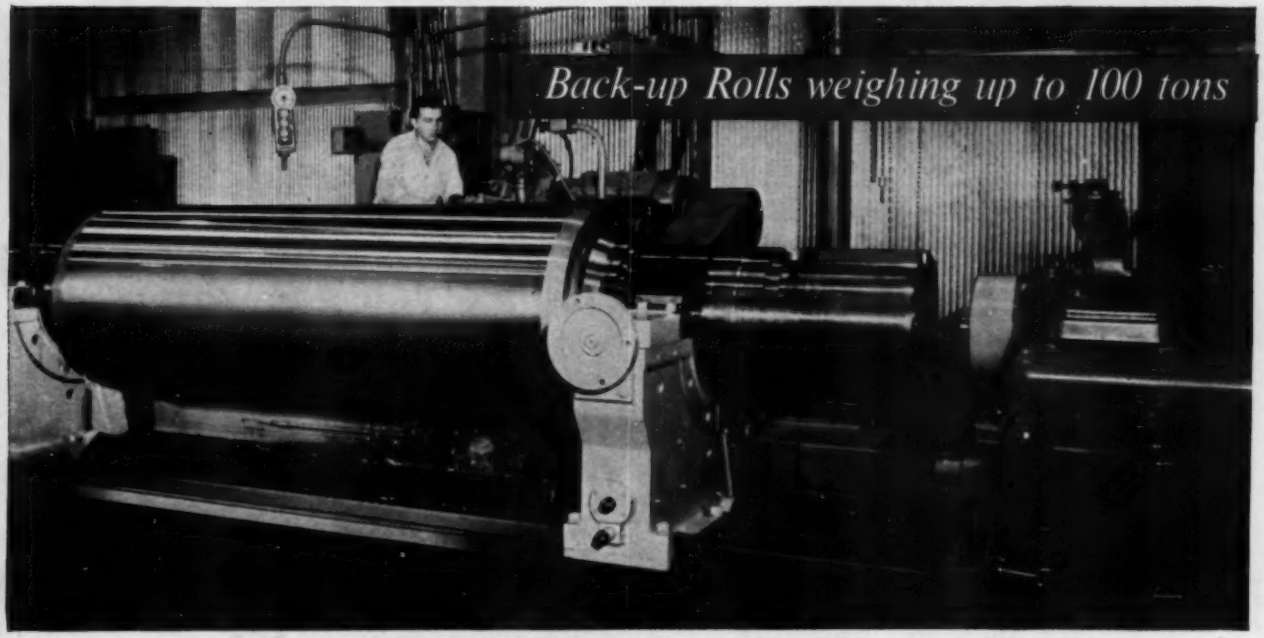

Big rolls, dwarfing the operator, are ground on a CINCINNATI FILMATIC 60" x 312" Traveling Wheelhead Roll Grinder. (Photo courtesy Kaiser Aluminum & Chemical Corporation)

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WORK PIECE					HOB (1 start)				Pieces per Load	Method*	Time per Piece	Pieces per Grind	Cut
Dia. Pitch	No. of Teeth	Helix Angle	Face Width	Material	Dia.	RPM	Feet PM	Feed					
10	20	15°	1¾"	1040 leaded	3"	500	395	.055"	1	A	2 min. 25 sec.	150	Finish
7	23	13°	¾"	8620	4"	350	370	.100"	2	A and B	59 sec.	240	Pre-shave
5	43	24°	1⅝"	8620	4"	280	300	.100"	2	B	3 min. 45 sec.	80	Pre-shave

** Method A: Diagonal Hobbing. Method B: Step-by-step Hobbing.*

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HIGH-SPEED HOBBING. Performance speaks louder than words. The examples given above show the results of high-speed hobbing which can cut costs. The figures are taken from the records of typical production runs on the Fellows-Pfauter P400.

DESIGN. The P400 was designed for High-Speed Hobbing, and it features a new basic design. The individual machine elements are of maximum rigidity. The hob head is heavy and rugged, the machine column and bed are of double-wall construction with heavy V-ways and the work table is as large as the maximum permissible work piece diameter. The index worm gear is nearly as large as the work table, and the work support column is of massive construction. All parts of the machine are properly proportioned and of sturdy design to eliminate vibration. The cost is more than justified by the resulting reductions in hobbing times and the increased hob life.

RIGIDITY and CLOSE TOLERANCES. The large size work table and index worm gear and the oversize hob head, which eliminates lead errors caused by hob breakout, are important factors in providing the rigidity necessary to hold work to close tolerances.

COMPLETELY OPEN WORKING AREA. The machine and the work-support columns are of such rigid construction that the hobbing stresses are absorbed without requiring an over-arm. Therefore the working area is easily accessible for set-up and work loading. The automatic retraction of the table from the hob also facilitates changing of work.

SET-UP TIMES and FLOOR-TO-FLOOR TIMES are reduced on the P400 because it has infinitely variable speeds and feeds, rapid traverses for all machine movements, including hob shifting manually by push button, and built-in hydraulics for the operation of the tailstock and simple hydraulic fixtures used on this machine.

AUTOMATION on the P400 is simple and fast. The illustrations show a machine equipped with automatic loading and unloading devices.

GEAR HOBBING COSTS can be cut by high-speed hobbing on a P400 because of the resulting savings in production time, floor space, maintenance and labor.

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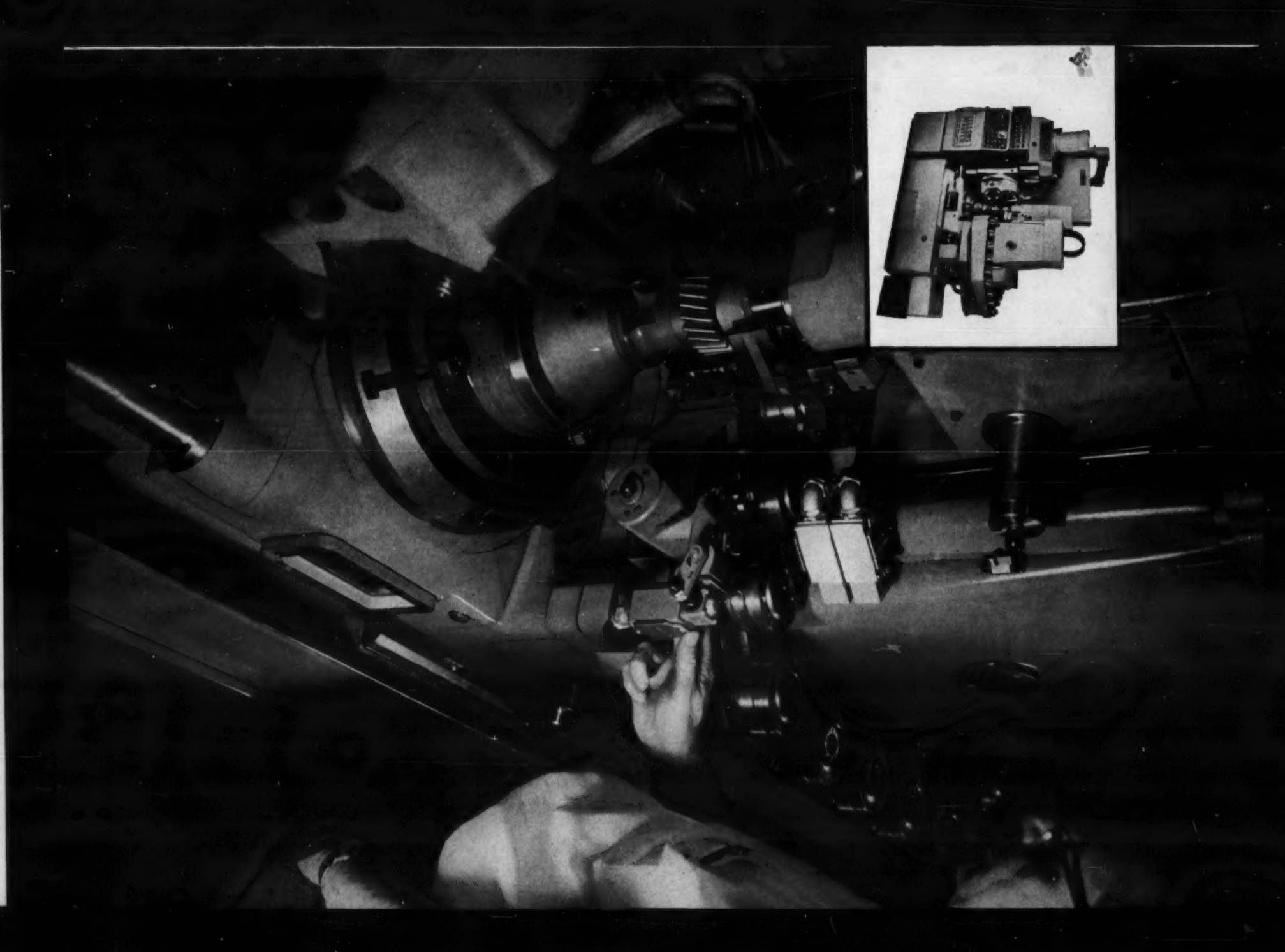

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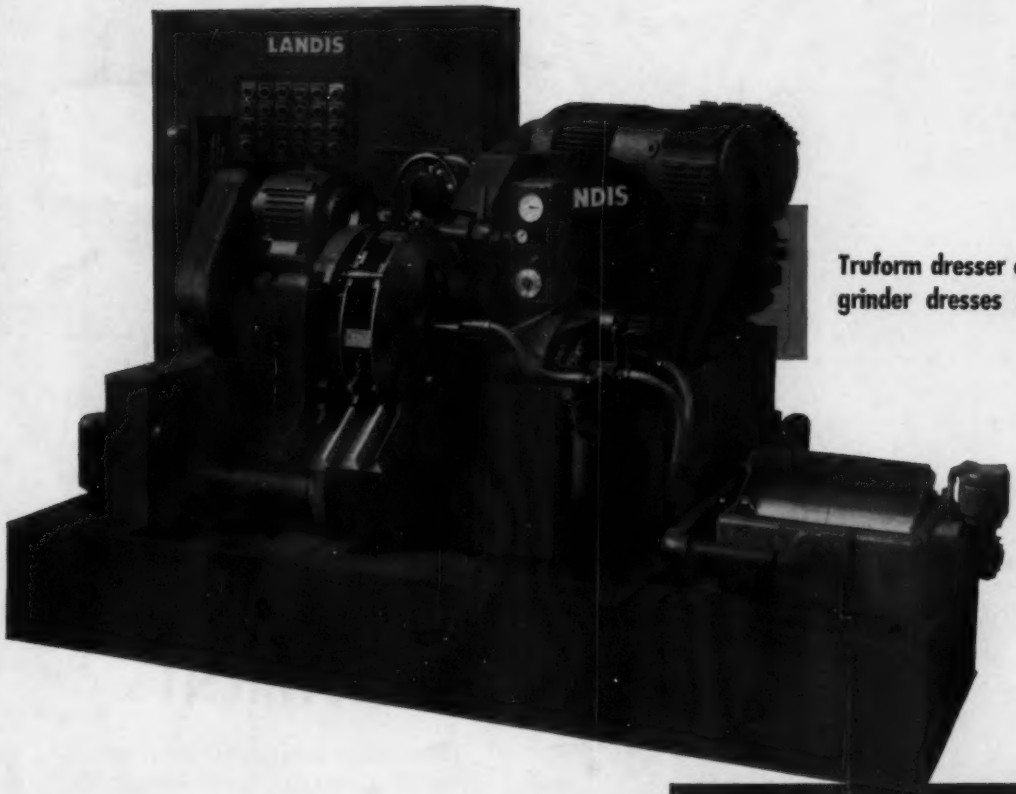

Truform dresser on Landis plunge grinder dresses unusual profiles

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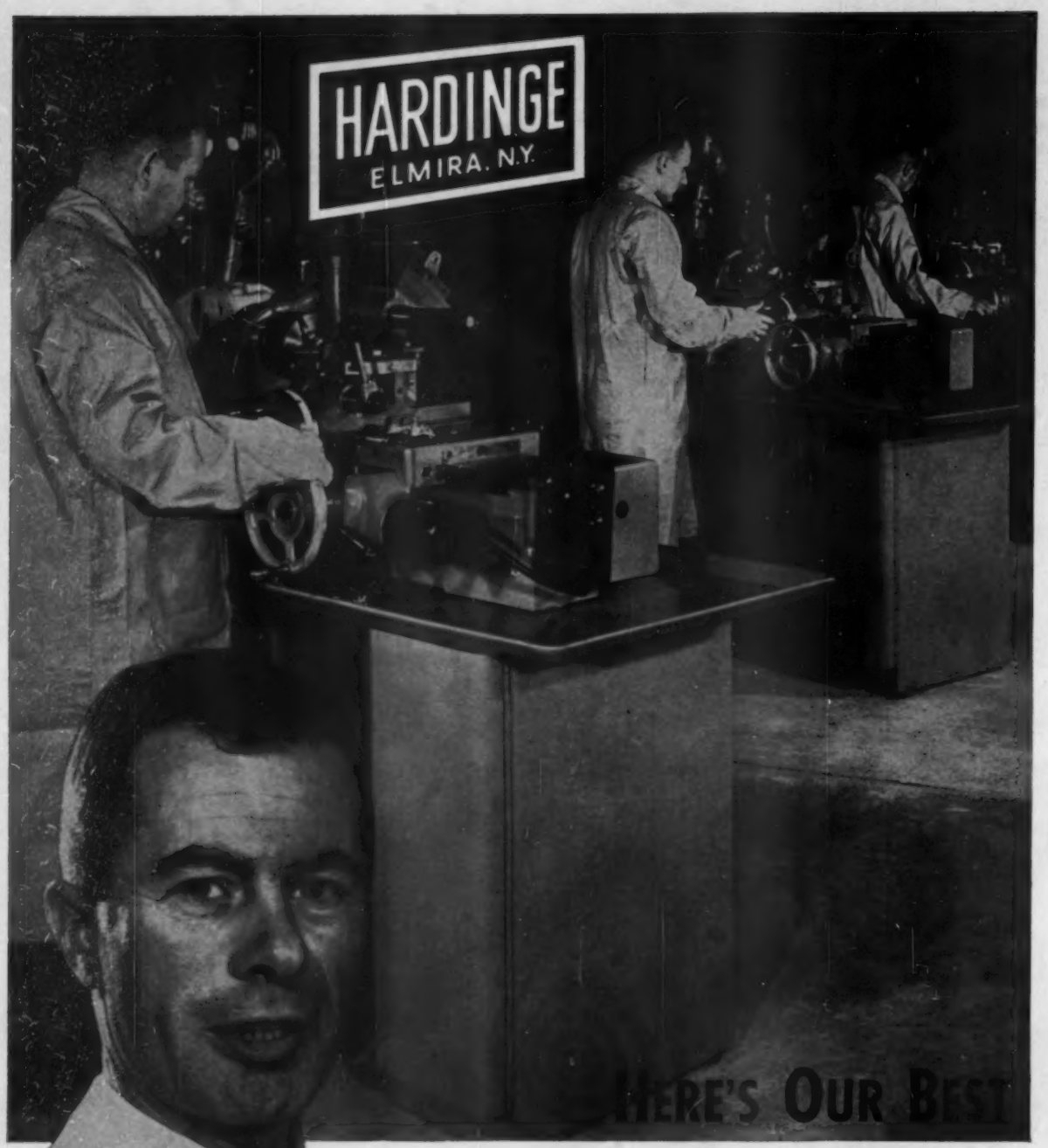

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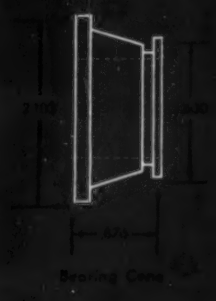
Gardner BKGR disc specification
- fast stock removal
- cool cutting
- effective chip clearance



Call the Gardner Abrasives specialist for practical solutions to your disc grinding problems

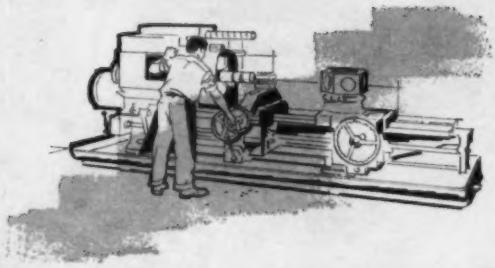
GARDNER

abrasive discs

BELOIT, WISCONSIN

The job illustrated is typical of work where large amounts of metal are removed. For example, one forging was reduced from 1850 lbs. as forged to 890 lbs. after machining. Material AISI-1045. Floor-to-floor time: 5¼ hours including setup and gaging.

AT CANN & SAUL STEEL COMPANY
Royersford, Pa.



80 lbs. of metal turned from this forging in 3 minutes

Warner & Swasey 36″ swing 5-A in progressive forge shop cuts metal full time at maximum rates yet provides fast handling for small lot production.

The 5-A turret lathe has the power and the rigidity to hog metal at this clip yet the same machine finishes work to .002″ or less for Cann & Saul. Heavy metal removal plus the ability to handle one to four-piece lots at low cost on a battery of Warner & Swasey's are but two reasons why Cann & Saul remains a leader in the competitive custom machined forging field. They make good use of the power built into the 5-A Extra Heavy Duty Warner & Swasey turret lathe by taking cuts up to 1″ deep at 300 SFPM and .025″ feed. The machine's 36″ swing and 12½″ hole through the spindle accommodates a wide variety of forging shapes.

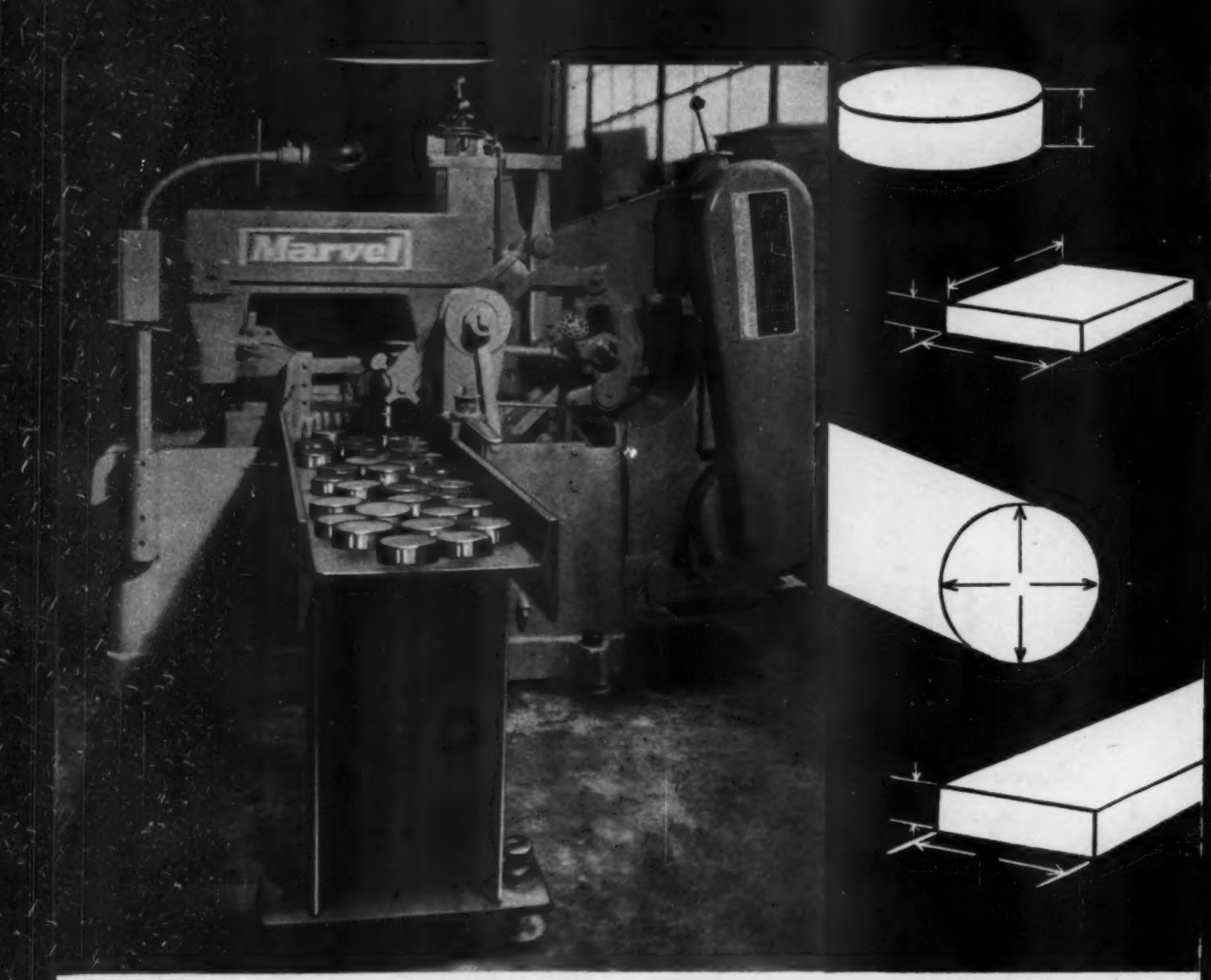
Rough forgings machined by the Cann & Saul Company include medium carbon steels, stainless, titanium and other alloys, and frequently are heat treated to 300 Brinell before machining. Eccentric and interrupted cuts are a stiff test of machine rigidity.

The hydraulic speed shifts and easy handling tool carriages help the operator to handle small lots efficiently . . . and the work is within easy reach for rapid gaging, an extremely important factor on a big machine like the 5-A.

For more information contact your resident Warner & Swasey Field Engineer, or Warner & Swasey Company, Cleveland 3, Ohio.

YOU CAN TURN IT BETTER, FASTER,
FOR LESS...WITH A WARNER & SWASEY

WARNER & SWASEY



ACCURATE

A hack saw blade, like any other cutting tool, must be rigidly held (tensioned) if it is to cut-off accurately. Also, the point at which tension is applied is important to accurate work. Two reasons why Marvel High-Speed-Edge Hack Saw Blades can make any hack sawing machine cut-off more accurately are:

1. They can be tensioned from 200% to 300% more tautly than ordinary blades with complete safety to the operator and the machine because they are unbreakable.
2. Location of the pin holes, by which the blade is held in the saw frame, concentrate these higher tensions at the working edge of the blade.

Ask for Marvel High-Speed-Edge Hack Saw Blades by name and you can be sure you're getting the unbreakable blades designed to give you maximum accuracy, speed and safety in your cutting-off operations. Leading Industrial Distributors have Marvel Blades in stock.

Write for latest Cutting Tool Bulletin and the name of your nearest Marvel Distributor.

MARVEL *Metal Cutting* **SAWS**

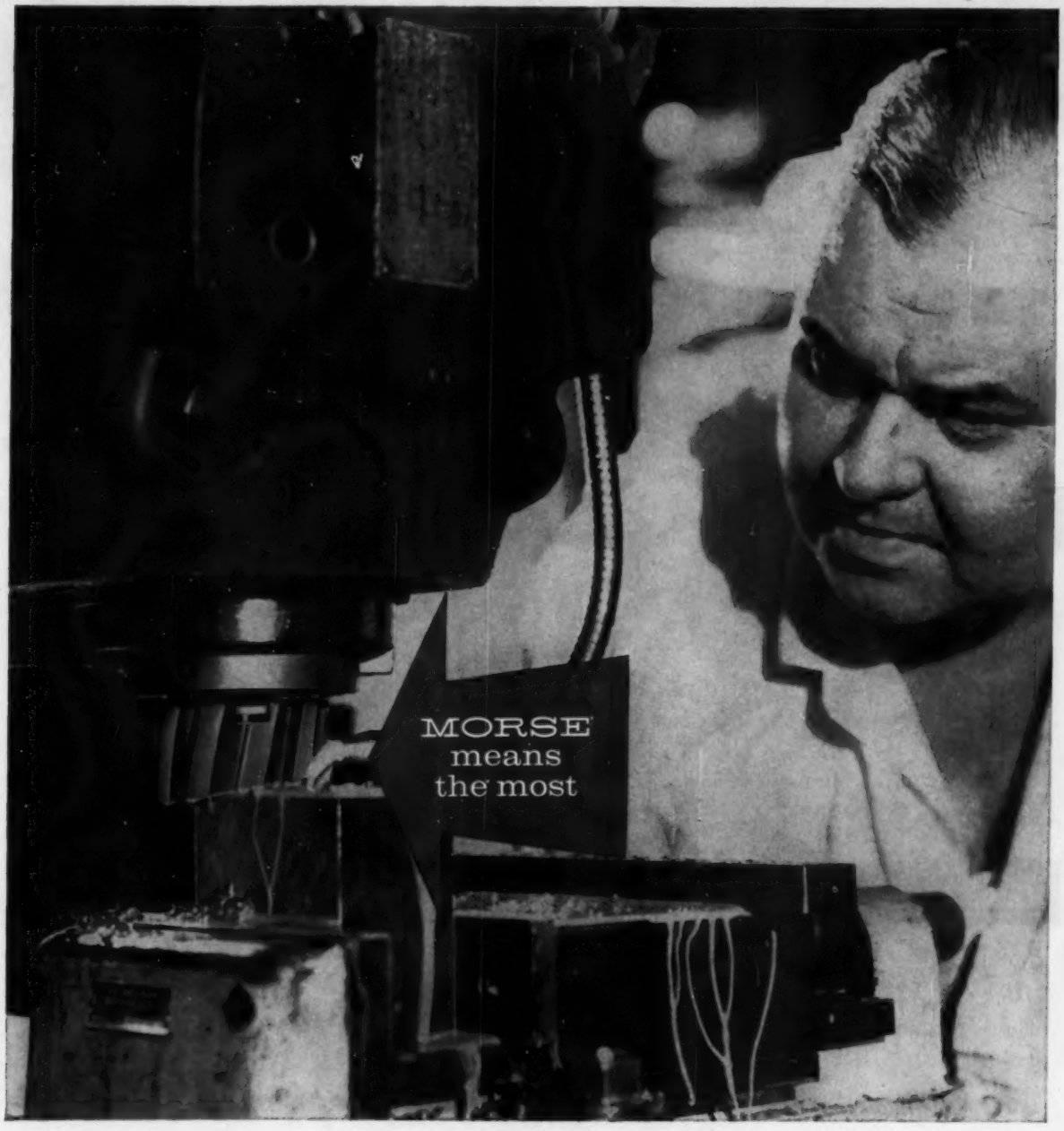
BETTER MACHINES
BETTER BLADES

ARMSTRONG-BLUM MANUFACTURING CO. • 5700 Bloomingdale Avenue • Chicago 39, Illinois

CIRCLE 165 READER SERVICE CARD

B-1129

with men who know cutting tools... it's MORSE everytime



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SEE YOUR NEARBY MORSE DISTRIBUTOR

MORSE

MORSE TWIST DRILL & MACHINE CO.
NEW BEDFORD, MASSACHUSETTS

A Division of VAN NORMAN INDUSTRIES, INC.
4124

WAREHOUSES IN: NEW YORK • CHICAGO • DETROIT • DALLAS • SAN FRANCISCO

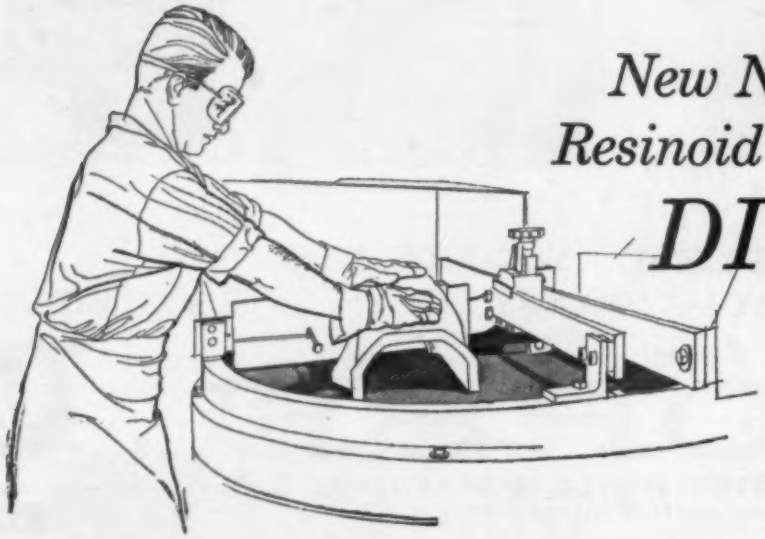
CIRCLE 166 READER SERVICE CARD

Profit by the big advantage plant after plant is already using . . .

Hit that new high in

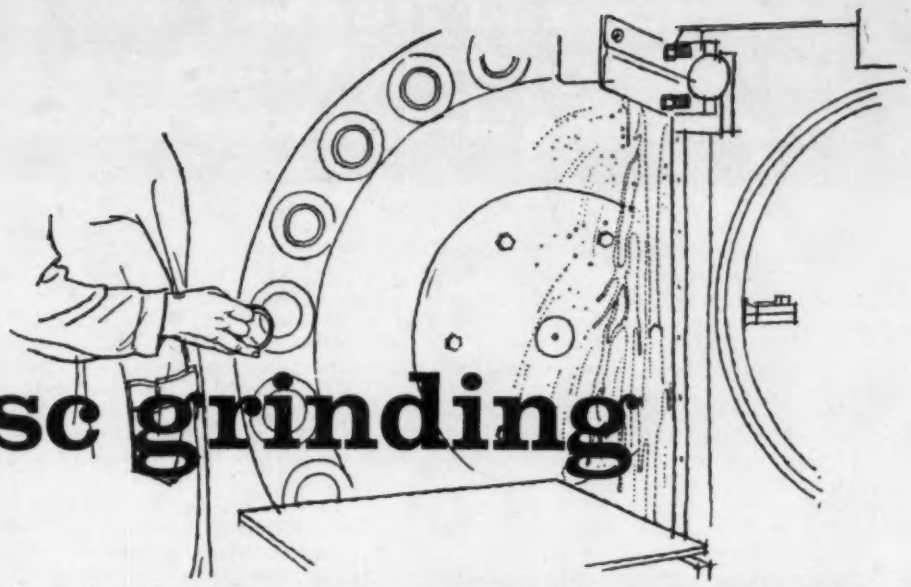
with

B14



New Norton Resinoid Bonded

DISCS



disc grinding

Throughout the country plant after plant is showing real enthusiasm for the new economy — and profits — the Norton-developed B14 resinoid bond has brought to the finest disc wheels ever made.

Development of the new B14 bond involved not only improvements in bond material but entirely new processing.

It took several years to perfect these changes. It also took many months to complete nation-wide testing of the new B14 discs, on all types of disc grinders — horizontal or vertical spindle, single or double — on jobs ranging from snagging to precision finishing, and on ferrous, non-ferrous and non-metallic materials. Also, the tests were entirely comparative — not only against competitive wheels but against Norton discs which were then standard.

Results of this across-the-board testing are outstanding. The new B14 discs have proved beyond question their ability to grind more workpieces per disc . . . faster and better, with fewer dressings . . . and with constant uniformity throughout extra long disc life.

Let new B14 discs bring you proof of better lower cost surfacing. Have your Norton Man, a trained abrasive specialist, study your requirements and make trial runs of the B14's you need — solid discs or segmental, ALUNDUM* or CRYSTOLON* abrasive. Or get details from your Norton Distributor. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Trade-Marks Reg. U.S. Pat. Off. and Foreign Countries

A few of very many reports from Norton customers . . .
PROVING B14 DISCS THE BEST

JOB: Rough grinding iron castings, 3¼" x 2½".

REPORT: **B14 37 CRYSTOLON wheel ground 6,000 parts with one dressing. Best previous disc gave 4,500 parts with 4 dressings.**

JOB: Surfacing cold rolled steel washers on double disc machine.

REPORT: **B14 19 ALUNDUM discs impressive as best so far, with very even wear.**

JOB: Through-feed grinding of 52,100 steel bearing races.

REPORT: **B14 ALUNDUM disc very free cutting, clean and cool. Longer life than previously used Norton disc.**

JOB: Double-disc grinding Alnico magnets.

REPORT: **B14 mixed-abrasive wheel thoroughly approved for new orders.**

JOB: Double-disc grinding abrasive sticks.

REPORT: **B14 37 CRYSTOLON disc gave improved rate of cut. More abrasive sticks per disc-dressing.**

JOB: Rough grinding miscellaneous parts on double end machine.

REPORT: **B14 44 ALUNDUM disc performed better, lasted longer than all types.**

NORTON
ABRASIVES

W-2009

Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Non-Slip Floors — BEBR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

CIRCLE 168 READER SERVICE CARD

CIRCLE 169 READER SERVICE CARD ►

Sectionized Transfer-matic Introduces New Concepts of Processing 4-Cylinder Blocks

A significant forward step in automation has been achieved by a new Cross Transfer-matic which integrates all operations except broaching that are required to finish cylinder blocks of three different horsepower capacities. The multiplicity of operations in a single machine and the fact that the entire line was created by one builder result in large reductions in engineering, materials handling, control circuitry and floor space.

The new Transfer-matic consists of six sections with a total of 121 stations. Three banking conveyors are provided between appropriate sections.

In Sections I and II, most of the heavy metal removing operations are handled. These include straddle milling the main bearings, milling the oil slinger grooves, rough drilling the valve lifter holes, rough boring the cylinders, rough boring the camshaft and milling the ends of the block.

In Section III, the sides are completely machined and the accessory and engine mounting pads are milled.

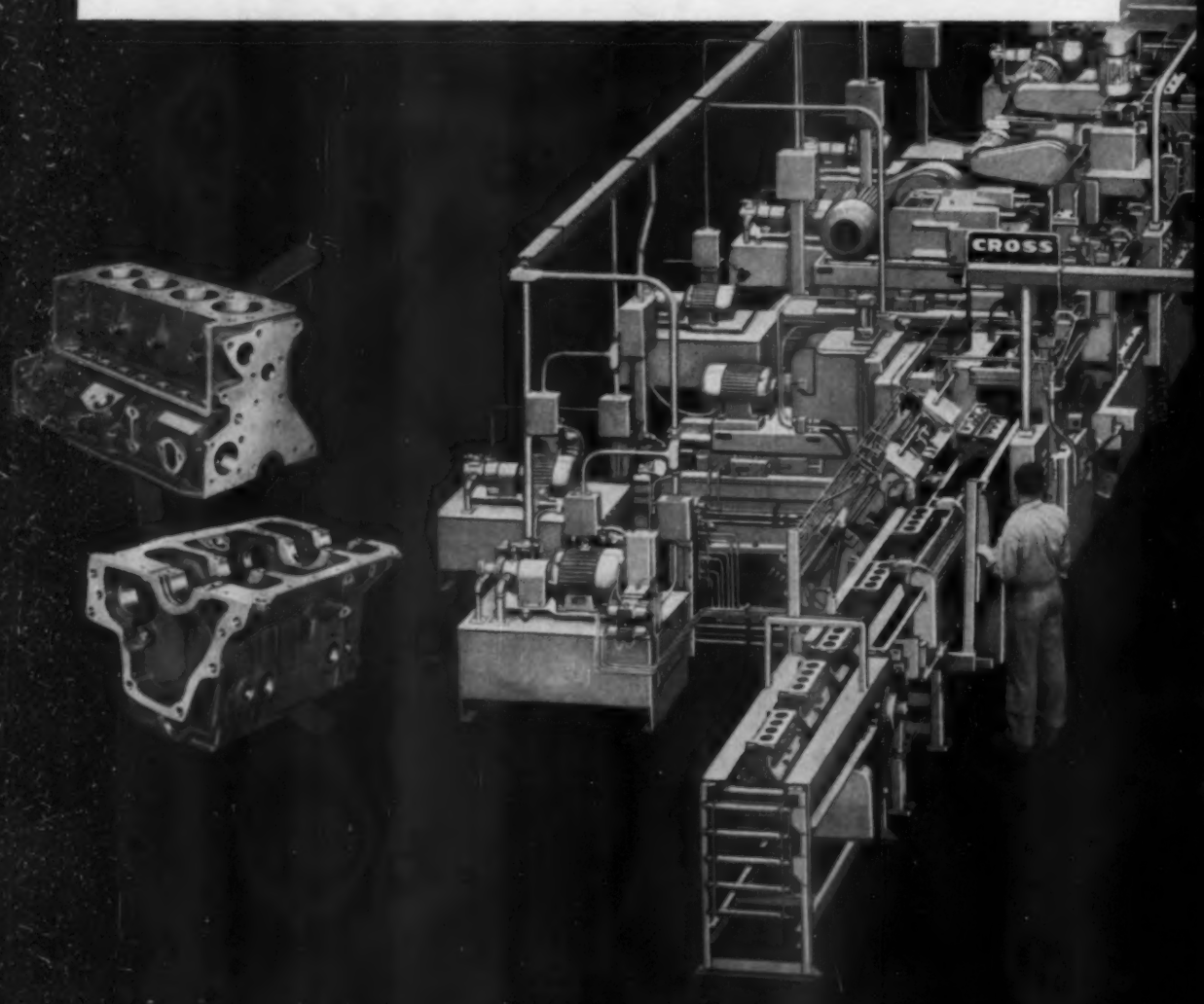
In Section IV, the operations on the top and bottom of the part are performed and the valve lifter holes are finish machined. A special coolant system is employed.

In Section V, the block is washed and the bearing caps are assembled.

In Section VI, the cam and crank boring operations and inspections are completed.

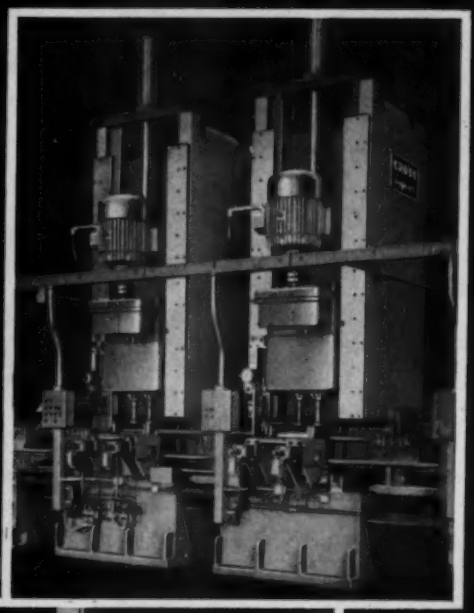
At 100% efficiency, production is at the rate of 109 blocks per hour.

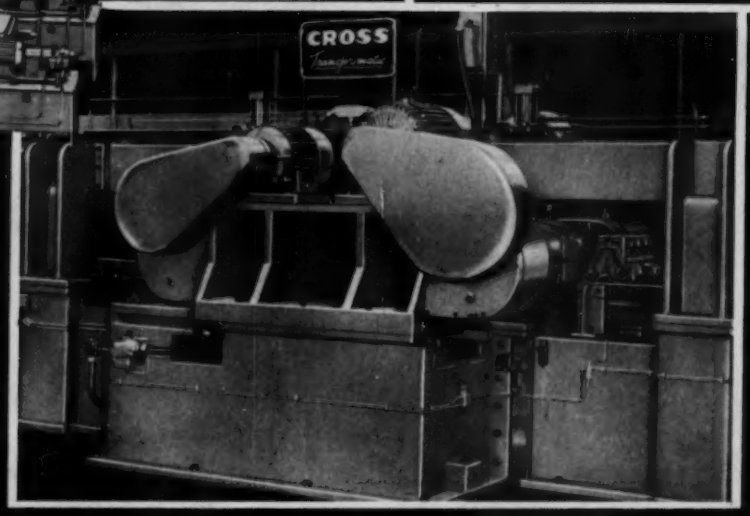
A Cross sales engineer would like to acquaint you with features of this Transfer-matic in detail.



Another Transfer-matic by Cross

Alternate cylinders are rough bored in adjacent stations.





Rough and finish milling both ends of the block.

Established 1898

THE CROSS CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

Here's what we mean by . . . .

LAPOINTE **builds these tables** with high load capacity (up to 25 tons), to perform to an accuracy not available from any other similar tables.

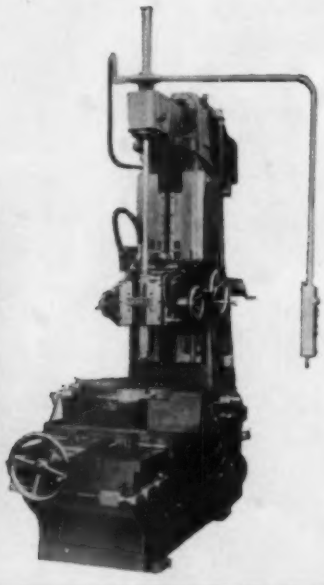
The degree of accuracy that can be obtained is given in the individual descriptions of these four variations of standard table components. Tables can be modified to suit your special requirements. We invite your inquiries, either direct or through one of our experienced Field Engineers.

THE LAPOINTE MACHINE TOOL COMPANY

HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*

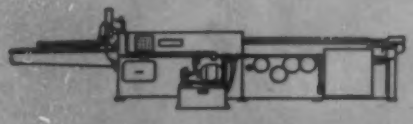
THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES

Index accuracy of ± 3 seconds of arc is built into this 30" Lapointe Rotomatic Positioner, mounted on a special precision automatic hole positioner. Machine is adaptable to numerical control, either one, two, or three axes.



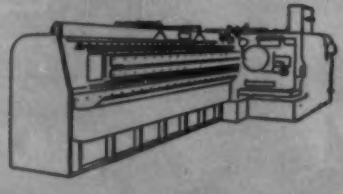
Index accuracy of ± 8 seconds of arc is built into this 48" Lapointe Rotomatic Positioner, mounted under a radial drill.

Lapointe-built Broaching Machines are available in hydraulic and electro-mechanical drives.



60" STROKE HORIZONTAL, ELECTRIC

CH CONTINUOUS BROACHING, ELECTRIC



SRHE SINGLE RAM HORIZONTAL, ELECTRIC

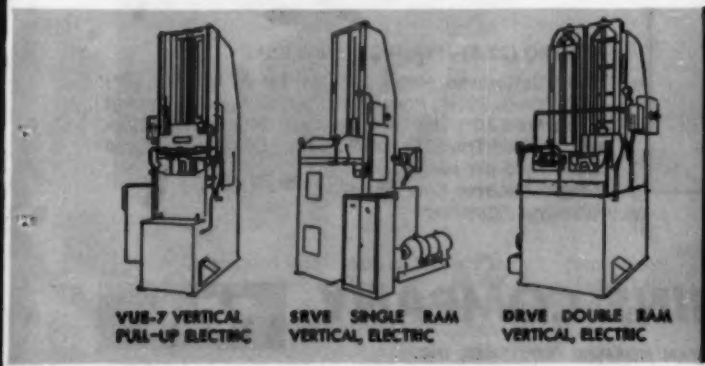
◀ CIRCLE 170 READER SERVICE CARD

CIRCLE 171 READER SERVICE CARD

. . . . ACCURACY
the pictures tell the story!

Special Lapointe Milling Table. 36" Rotomatic Positioner, adapted for milling through a special gear box. Under push button control. Direction of rotation in either direction. • Feeds reversible and infinitely variable between 1" per minute and 40" per minute, with a rapid traverse of 72" per minute. • Table equipped with adjustable trip dogs to stop rotation at pre-set points. • Can be interlocked with milling machine for fully automatic operation. Can also be rotated by hand with dial graduated to read 1 minute.

This Lapointe table has rapid rotation under push button control, with final setting manually through a vernier graduated dial calibrated to 2 seconds of arc.



VUB-7 VERTICAL PULL-UP ELECTRIC

SRVE SINGLE RAM VERTICAL, ELECTRIC

DRVE DOUBLE RAM VERTICAL, ELECTRIC

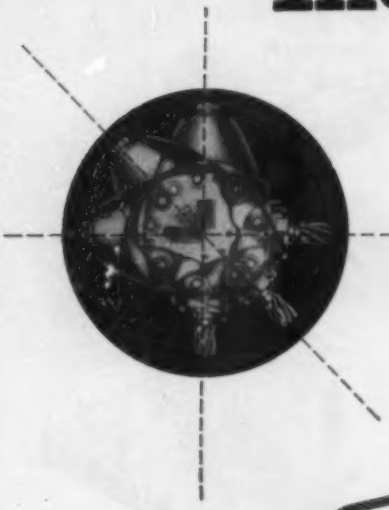
LAPOINTE

known to be the best in

BROACHING

All industry is talking about the new Van Norman

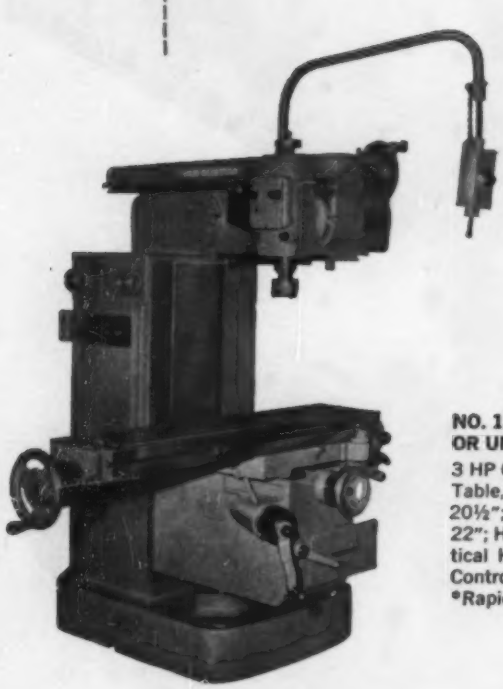
Increase Production Van Norman



Horizontal, Angular or Vertical Milling are at your finger-tips with ONE Van Norman Ram-Type Miller. Versatility and Range Pay Off in Performance

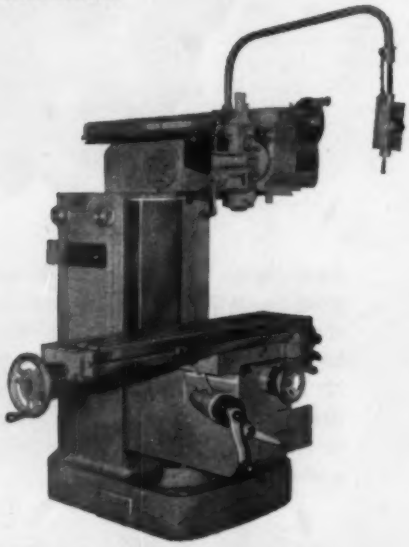
A single investment in one Van Norman Ram-Type Milling Machine gives you the equivalent of two separate millers plus attachments at the much lower cost of a single machine. Not only do you save machine dollars, but with a Van Norman you get increased production with substantial savings in milling costs.

14 new standard models — cutterhead motors from 3 to 10 HP (*15 HP optional)—table sizes from 42½" x 10" to 64" x 14" (*72" x 16" optional). You thus have a wide range of selection to fit your needs most exactly. Write for individual catalogs giving complete information. Mail to: Van Norman Machine Company, Springfield 7, Massachusetts.



NO. 1R (22-3)—PLAIN OR UNIVERSAL

3 HP Cutterhead Motor; Size of Table, 42½" x 10"; Ram Travel 20½"; Power Longitudinal Feed 22"; Hand Cross Feed 10"; Vertical Hand Feed 24"; Pendant Control.
*Rapid Traverse Knee Elevating



NO. 1RQ (22-3)—PLAIN OR UNIVERSAL

3 HP Cutterhead Motor; Size of Table, 42½" x 10"; Ram Travel, 20½"; Power Longitudinal Feed 22"; Hand Cross Feed 10"; Vertical Hand Feed 24"; Pendant Control; 4" Quill Travel; 3 Power Feeds (.0015" - .003" and .006" Feed per revolution).
*Rapid Traverse Knee Elevating
*Optional Equipment

FOR YOUR CONVENIENCE..
NEW NUMBER DESIGNATIONS FOR VAN NORMAN MACHINES

1	R	Q	22	3
Class	Ram Type	Quill Spindle	Table Travel	Spindle HP

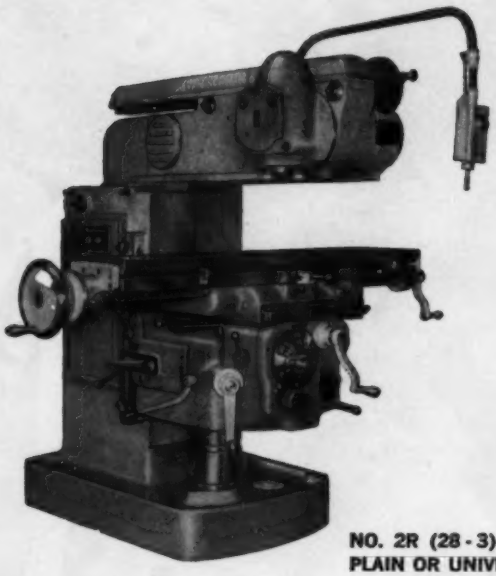
4129

VAN NORMAN MACHINE COMPANY

VN

SPRINGFIELD 7, MASSACHUSETTS • DIVISION OF VAN NORMAN INDUSTRIES, INC.

Efficiency with Ram-Type Millers

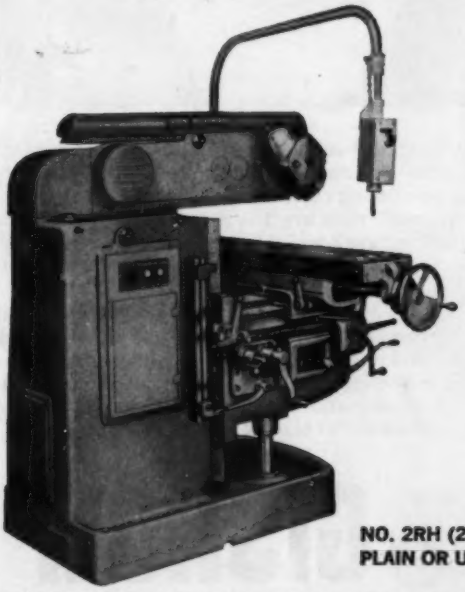


NO. 2R (28 - 3)—
PLAIN OR UNIVERSAL

3 HP Cutterhead Motor. Size of Table: 50" x 10½". Ram Travel: 29". Power Longitudinal Feed 28". Power Cross Feed 12". Power Vertical Feed 18". Rapid Traverse (6 Directions); Pendant Control; Front and Rear Hand Controls.

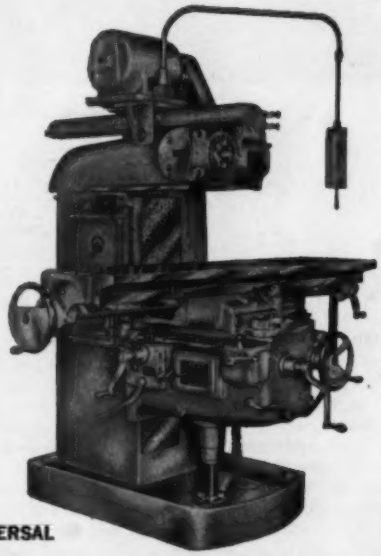
NO. 2R (28 - 5)—
PLAIN OR UNIVERSAL

5 HP Cutterhead Motor. Size of Table: 50" x 12". Ram Travel 25". Power Longitudinal Feed 28". Power Cross Feed 12". Power Vertical Feed 20". Rapid Traverse (6 Directions); Pendant Control; Front and Rear Hand Controls.



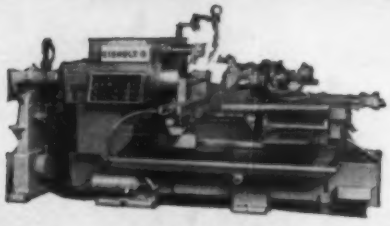
NO. 2RH (28 - 7½)—
PLAIN OR UNIVERSAL

7½ HP Cutterhead Motor. Size of Table: 58" x 13". Ram Travel 29". Power Longitudinal Feed 28". Power Cross Feed 14". Power Vertical Feed 20". Rapid Traverse (6 Directions); Pendant Control; Front and Rear Hand Controls.



NO. 38MA—
PLAIN OR UNIVERSAL

10 HP Cutterhead Motor. Size of Table: 64" x 14". Ram Travel 29". Power Longitudinal Feed 35". Power Cross Feed 14". Power Vertical Feed 21¼"; Rapid Traverse (6 Directions); Pendant Control; Front and Rear Hand Controls Automatic Backlash Eliminator with Plain Saddle.



GISHOLT MASTERLINE AR TURRET LATHE Converts for bar or chucking work in less than one hour. Sets up like a turret lathe, from the front—no gears to change—uses same standard tools. Cycle setting is learned in less than a day. Compare these extras: greater capacity at lower original cost than any comparable automatic; automatic withdrawal for chip clearing in deep holes; internal threading with solid taps requiring spindle reverse; external threading with self-opening die heads and automatic re-cocking; reverse feed and individually adjustable dwell to all tool stations; 16 spindle speeds and infinite feeds—none lost when threading. Optional: 8-sided turret; overhead cut-off slide or swinging stock stop; automatic recessing slide tools; JETracer® with turret slide tools.

Ask your Gisholt Representative for a desk-side demonstration, or write for Catalog 1224.

With recent developments in automatic machining, many manufacturers—maybe your toughest competitors—are cutting costs substantially.

Even small runs are going automatic—both bar and chucking work too! All this with the Gisholt AR® Turret Lathe at little more than the cost of a hand-operated turret lathe.

This is no exaggeration: the Gisholt AR can cut your *direct* machining costs by 25% to 40% on work now handled on manual lathes—can give you *indirect* savings in tooling, inventory, setup, inspection, materials handling and floor space. Investigate AR—your best answer to the cost-profit squeeze.

GISHOLT
MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

Turret Lathes • Automatic Lathes • Balancers • Superfinishers® • Threading Lathes • Factory-Rebuilt Machines with New-Machine Guarantee

ANOTHER NORTON PRODUCT

Push up the output
with RESINALL belts

DOWN goes production time and up go profits. That's the story time and time again with Behr-Manning *resin*-bonded* belts and discs. There's less breakdown from heat and loading; more and better cutting per belt dollar.

We can prove it . . . and will. Just ask for an in-plant demonstration. Write Dept. AM-3, BEHR-MANNING CO., Troy, N. Y., a division of Norton Company.

*RESINALL . . . an all-resin-bonded aggressive belt of strong X-weight cloth, for maximum heat resistance in most all rough and intermediate grinding operations.

*RESINIZED . . . a resin-over-glue belt of good heat resistance, in strong X-weight for flat polishing, and in flexible J-weight for contour polishing.

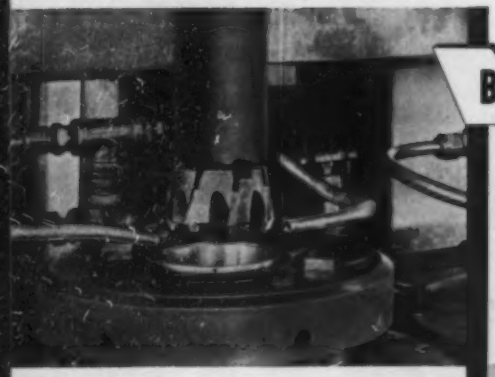
BEAR BRAND Abrasives

(Guard has been removed from machine for photo.)

FOR MILLING...

MILLING

By combining conventional Rigidcut and throw-away cutters on the same job, straddle milling valve bodies, Wesson cut cost from 83c to 21c per 100 parts, cut down-time, boosted production. (Wessonmetal GI used.)



BORING

Wesson Job-engineering cut steel cylinder sleeve boring time with carbides from 10 minutes to 20 seconds, multiplied pieces per grind 25 times, output per spindle 34 times. (Wesson ST 17272 cutter used with tipped Wessonmetal GI blades.)

TURNING

Wesson proved that cast steel armorplate could be turned with throw-aways at a saving of 43% in tip cost per piece. (T-A Holder and Wessonmetal HR carbide used.)

CIRCLE 177 READER SERVICE CARD

WESSON COMPANY • WESSON METAL CORP. •

...THROW-AWAYS or CONVENTIONALS?

make it easier to decide...

Two new advances in milling cutter design by Wesson . . . which makes BOTH throw-away and conventional cutters . . . now make it possible for throw-aways to do two things (see illustration at right):

- **eliminate the run-out problem, and**
- **produce extra fine finishes**

With these problems solved, it is a matter of what is best on your own jobs. Here is where the Wesson man can help you. He was picked for his milling, turning and boring know-how, for his experience in getting the most out of any milling cutter . . . conventional or throw-away.

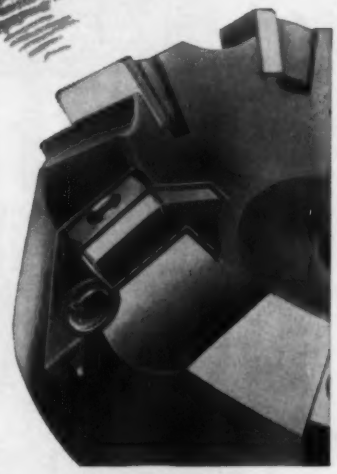
Let him work for results in your plant like those shown at the left . . . typical of what Wesson's in-plant service is doing for others. He costs you nothing. He's as near as your phone.

Back of his recommendations is the experience of the entire Wesson group of 4 specialized tool plants, plus Wesson's basic research, application research and tool engineering groups, plus its own carbide metals plant.

Don't forget Wesson offers another 'plus': grades specifically developed by Wessonmetal for milling with throw-aways and milling with conventionals.

To make it easier to decide, too, send today for Wesson's Booklet: "How to mill with conventional and throw-away cutters." It's quite a help.

Wesson Company, 1220 Woodward Heights Blvd., Ferndale 20, Michigan. In Canada: Wesson Cutting Tools Ltd., 93 Judge Road, Toronto 18, Ontario.

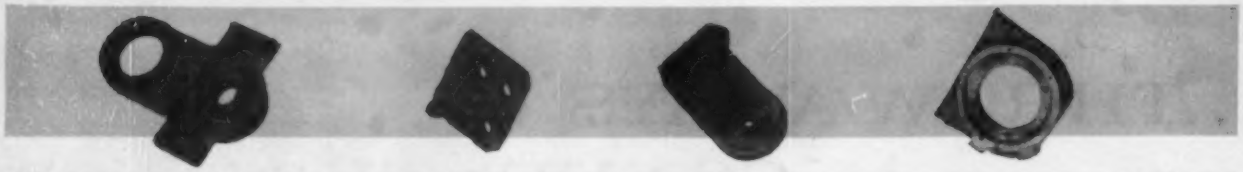


2 More New Wesson Developments

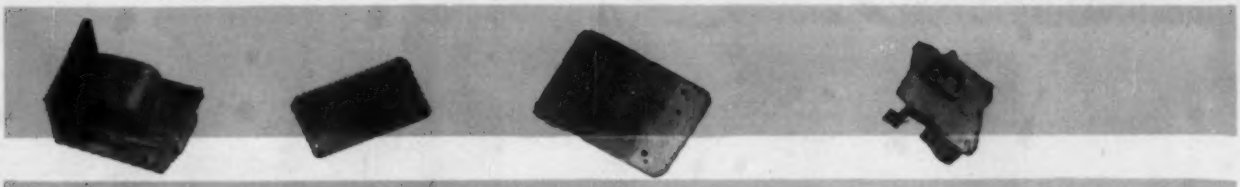
Ability to finish consistently to less than 50 microinches and finish mill without runout is now possible with the new Wesson throw-away cutters with one Micro-Finishing blade and adjustable tapered pins.

WESSON

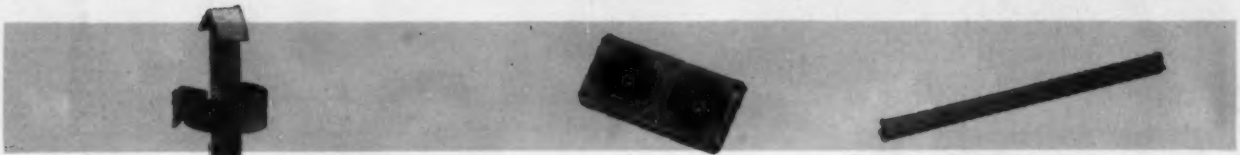
WESSON CUTTING TOOLS LTD. • WESSON PRODUCTS CO. • WESSON RESEARCH ARCHER & SMITH • WESSON MULTICUT CO.



Drill—ream—tap—counterbore—mill all of these



jobs and many more without once changing tools



Drilling Department in One Machine

Reduce Drilling Costs 300 to 600%

Why take time out to change tools? All the tools you need for dozens of different jobs (like those above) are housed in the 32 spindles of the Fosmatic Turret Drill. You can drill, tap, ream, or mill in rapid sequence with this versatile machine tool.

Maintain Firm Production Control

With the Fosmatic Turret Drill you know your costs before you start a job. Cycling time is pre-planned. The variables of speeds and feeds, the absolutes of dimensions are all pinned down in the tape. You even know tape preparation time — it averages one minute per operation from blueprint to punched and proved tape.

Eliminate Jigs and Fixtures

Now a simple, 8-channel paper tape does the work of costly tooling. Table and saddle motions, spindle selection, speeds and feeds on the Fosmatic Turret Drill are numerically controlled by a General Electric Mark II system. Fosdick's own Fosmatic system controls spindle depth and traverse. These are numerical control systems you can depend on.

You'll want more information on this remarkable new machine. Write for Bulletin FTD — and get a proposal from Fosdick.

The Fosdick Machine Tool Co., Cincinnati 23, Ohio

FOSDICK

HIDDEN VALUES in Finkl Products

This mark tells you a product is made of modern steel.

FINKL *CRAFTSMANSHIP* at NO EXTRA CHARGE!

You pay a premium for the finest automobiles, watches, furniture, clothes, and household appliances because they are well designed, the best made, with the finest materials, by experienced craftsmen.

In Finkl forgings, die blocks, hot work steels, and forge repair parts, you get the best in quality controlled electric furnace steels, forging, heat treatment, precision machining, and metallurgical inspection. All these operations are supervised and accomplished by craftsmen in their own right, backed by over eighty years of Finkl experience . . . yet you don't pay a premium for Finkl products.

We have always maintained that "the best is the least expensive in the long run." We practice it ourselves. The best materials and equipment in the hands of the best qualified men produce products that have longer life, require less maintenance, and mean greater production potentials for you.

You get more from Finkl in quality products, continuing research, and engineering service. Call your Finkl representative for your forging, hot work die steel, die block, and forge repair part needs.

Write to Dept. A, on your company letterhead for free BULLETIN 400. It shows the wide variety of custom forgings that are produced and many of the facilities for producing them.

DIE BLOCKS · FORGINGS · HOT WORK STEELS · ELECTRIC FURNACE STEELS

A. Finkl & Sons Co.

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Offices in: DETROIT • CLEVELAND • PITTSBURGH • INDIANAPOLIS • HOUSTON • BOSTON
COLORADO SPRINGS • SAN FRANCISCO • SEATTLE • BIRMINGHAM • KANSAS CITY • MILWAUKEE
LOS ANGELES Warehouses in: CHICAGO • DETROIT • BOSTON • LOS ANGELES

You can turn a profit on a New Britain +GF+ Copying Lathe

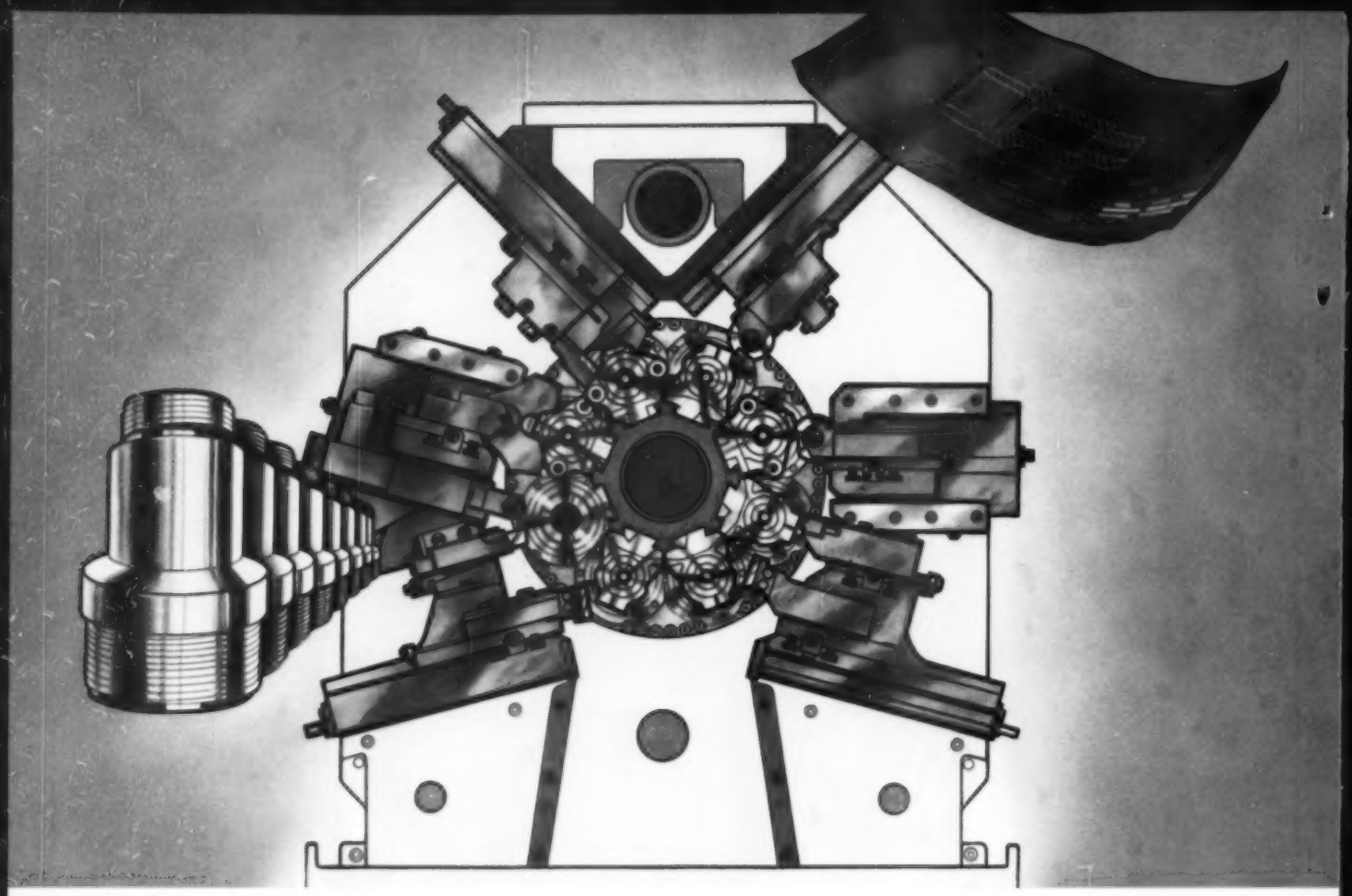
Here's a birdseye view of a New Britain **+GF+** Copying Lathe. It shows some important differences between this machine and conventional lathes with copying attachments. The point here is this—*the most effective use of the single-tool copy-turning principle can be made only with a machine designed from the ground up for this type of work.* The New Britain **+GF+** is just such a machine. Notice the chip pan. It's big (it has to be) and located for easy removal of chips from the back of the machine. The design of the work area allows for unobstructed free-fall of chips out of the way and into the pan.

The New Britain **+GF+** is massive and rugged, with plenty of power—up to 40 h.p., if you need it. It's simple to operate, quick to set up and change over. The single-point tool can be changed in one minute and it out-produces gang tooling setups in the bargain. Turning is controlled by either a template or a prototype. External and internal copying are accomplished in one set-up with special tooling.

The possibilities for short or long run chucked and between centers work on the **+GF+** are wide and varied. Because the work is produced with good surface finish and dimensional accuracy, grinding can be reduced and, in some instances, eliminated. Large diameters are broken down economically by successive parallel cuts, automatically if desired, with optional two-cut or multi-cut recycling.

You've got to see one of these machines in action to fully understand the kind and quantity of work they are capable of producing. Contact your New Britain Representative for demonstration arrangements or write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division - New Britain, Connecticut



Unlimited tooling combinations with New Britain Bar Machines

Nothing can out-date your operation quicker than better machines in the hands of a competitor. In the race to keep ahead on quality, price and delivery, nothing can put you out front faster than machines capable of consistently producing the highest quantity of finished pieces at the lowest possible cost. New Britain's new series of bar machines represents in every way the most advanced bar-turning units available. Each of the four-, six- and eight-spindle models has been redesigned, adding new features and improving older ones. Unlimited cross slide and end-working tool combinations, extremely fast operation (even on stainless) and a variety of models and features to choose from add up to some good reasons for incorporating New Britains into your replacement or production expansion plans.

The eight-spindle model is the largest, most modern eight-spindle bar machine available. It has a stock capacity of up to 2⅝" and provides six independently-operated cross slides. As with all New Britain bar machines, the operations of the cross slides and end-working tool slide are disc-cam controlled for positive actuation, close tolerance machining and easy, rapid change-overs.

This is only a very small part of a story that is bound to interest you. The whole story and its significance in terms of your profits is available from your New Britain Representative. If you prefer, contact us directly at The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division - New Britain, Connecticut

BETTER PROFITS THROUGH BETTER TOOLING WITH CARBOLOY® CARBIDE PLUSES

ANNOUNCING THE NEW CARBOLOY® TRACER IN THE ADJUST-O-BREAKER TOOLHOLDER FAMILY

Now you can choose your tracer toolholders with all the cost-cutting advantages of the Carboloy® Adjust-O-Breaker line. The newest addition to the Adjust-O-Breaker line, this tracer toolholder is available in 2 styles and 7 sizes to help you handle more jobs with less tooling.

The exclusive Adjust-O-Breaker design lets you adjust the chipbreaker from any angle . . . offers any desired adjustment within its range . . . features "floating" indexable chipbreaker with absolute repeatability. In addition to the tracers, you can choose from negative rake Adjust-O-Breakers (10 styles, 54 sizes), and positive rake (5 styles, 50 sizes), to meet most of your tooling needs more efficiently and economically.

Check today with your Authorized Carboloy Distributor — or write: *Metallurgical Products Department of General Electric Company, 11149 E. 8 Mile Road, Detroit 32, Michigan.*

CARBOLOY® CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

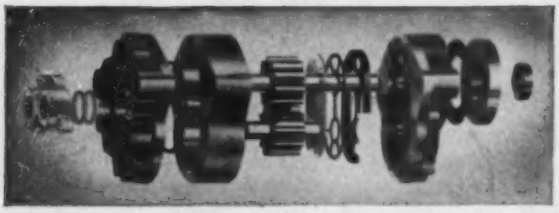
CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS • MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

◀ CIRCLE 183 READER SERVICE CARD

CIRCLE 184 READER SERVICE CARD

Precisionaire gages qualify parts and tolerances to tenths on as many as ten simultaneous dimension readings.

This fleet of PRECISIONAIRE® gages...
controls Cessna quality at the machines



Six models of this Cessna hydraulic pump, used on farm and construction equipment, are gaged during production.

Honing machine operator checks valve body bore at 9 points at once, determines .0001" classifications.

"Without the proper type and quantity of gaging equipment, we never would have been able to produce such high quality hydraulic pumps, valves, and cylinders at such low relative costs," reports the Industrial Products Division of Cessna Aircraft Company.

Knowing that bad pumps correlate with lack of gaging equipment, Cessna has a complete set of gages for each model pump, ready to roll to the machines for quick setup and start of production. Thirty-five rolling gage cabinets, carrying more than 400 Precisionaire columns, are used in the production of these pumps.

All pump parts are produced to be completely interchangeable—there is no classifying or selective fitting. This results in minimum investment in parts inventory, a very rapid rate of assembly, and practically no reworks.

Interchangeable parts greatly simplify replacement problems. Inventory is at an irreducible minimum, service problems are negligible, and users are happy with the minimum maintenance and maximum performance of the pumps.

Write for The Cessna Story and Precisionaire Catalog SPG-160. The Sheffield Corporation, Dayton 1, Ohio.

The SHEFFIELD Corporation Dayton 1, Ohio

A subsidiary of The Bendix Corporation

Inspection Gages, Dimensional Control Instruments, Machine Controls, Automatic Gaging & Assembly Systems, Measuray® X-Ray Thickness Measuring, Crushtrue® & Multiform® Grinders, Cavitron® Ultrasonic Machine Tools, Press-Pacer® Transfer Units, Large Dies, Tooling, Contract Manufacturing.

NOW! The Famous SPEEDICUT "CHIPBREAKER" in STUB SCREW MACHINE LENGTHS

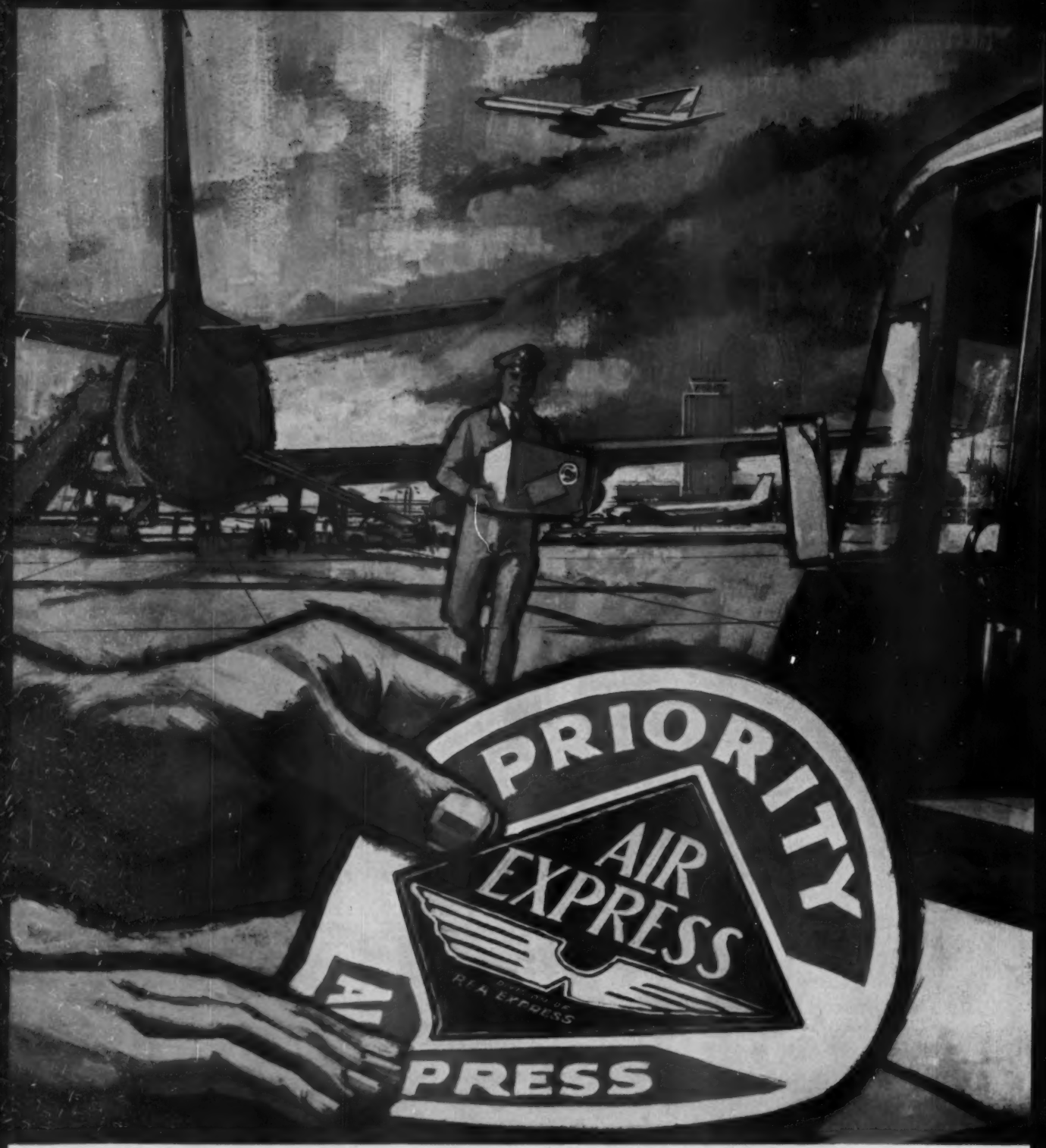
THE PATENTED RIB*
that cannot be duplicated

If your drilling operations include the use of screw machines and automatics, portable drilling equipment, hard metal drilling (such as stainless steel, high manganese, etc.), where short drills of extreme rigidity are necessary—you should try the new Stub Screw Machine Length SPEEDICUT "CHIPBREAKER." Permits uninterrupted drilling, eliminates down time for cleaning out packed spinnings and swarf. Your authorized SPEEDICUT "CHIPBREAKER" distributor will gladly arrange a demonstration in your plant. See for yourself how the SPEEDICUT "CHIPBREAKER," with the patented rib,* increases production, cuts drilling time and costs. Write today for brochure and name of local distributor.

*U.S. Patent Number 2769355

SPEEDICUT DIVISION, CHICAGO HEIGHTS STEEL CO., CHICAGO HEIGHTS, ILL.

CIRCLE 186 READER SERVICE CARD



Only Air Express assures top priority service for your product anywhere in the 50 states and Canada

It doesn't matter whether you ship a two-ounce radio tube or a one-ton piece of earth-moving equipment. The moment the AIR EXPRESS label goes into place your shipment gets top priority on all of the nation's scheduled airlines. We have enthusiastic users on both ends of the scale.

The reasons: your shipment flies with jet-age speed. And it flies first class—first on, first off, first there. No waiting ever for package consolidation.

CIRCLE 187 READER SERVICE CARD

Another is convenience—door-to-door service plus within-the-hour pickup by the AIR EXPRESS fleet of 13,000 special trucks, many radio-dispatched for maximum speed.

Kid-glove handling every mile of the way—to anywhere in the U. S. and Canada—is another AIR EXPRESS extra. Teletype receipt of delivery on request. That's why so many businesses are making the one phone call it takes to put AIR EXPRESS to work for them—at amazingly low cost—and they're doing it regularly. You'll like what happens to your competitive position, too, when you think fast . . . think AIR EXPRESS first! Call today . . . .

AIR EXPRESS

CALL AIR EXPRESS DIVISION OF R·E·A EXPRESS • GETS THERE FIRST VIA U. S. SCHEDULED AIRLINES

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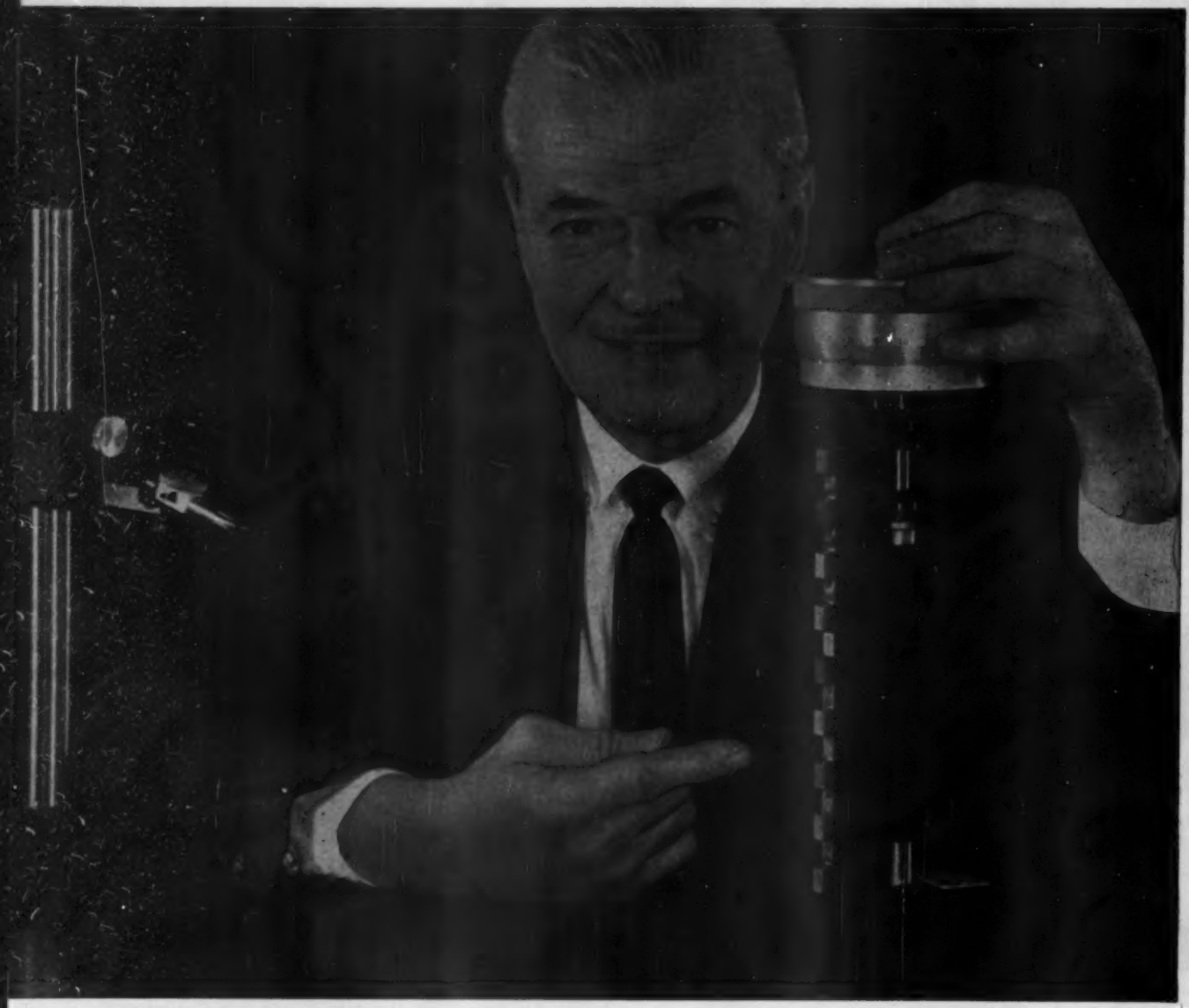
A "live" demonstration from Brown & Sharpe...

"Let me show you why Brown is the best height-setting"

...Mr. Ermand Watelet, Director of



"Let's start with speed... You can set up three or four heights, in tenths, with your 10" or 20" Hite-Set® — faster than you can get out your "Jo"-Blocks!

"You see — Hite-Set has a series of half-inch precision blocks, locked in a carrier on one-inch centers. A super-accurate micrometer head moves the carrier up and down 1", and with the mike at 0.0000", the tops of the blocks are at even inches—1", 2", 3", etc., high.

"You just pick the right block — turn the head to your ten-thousandth reading. The top of the block is then at the height you want, ready for transfer. What could be quicker!

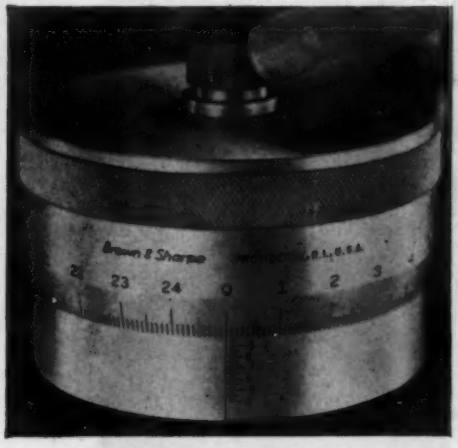
"Setting the bottom of blocks is easy, too, *without* attachments. You just subtract .5000".

"If you want even faster setting, there's Brown & Sharpe's 'Hite-Icator'. It's a Hite-Set with a dial indicator added that shows .1", .01" and .001".

This advertisement appears in American Machinist/Metalworking Manufacturing — Automotive Industries — Industrial Quality Control

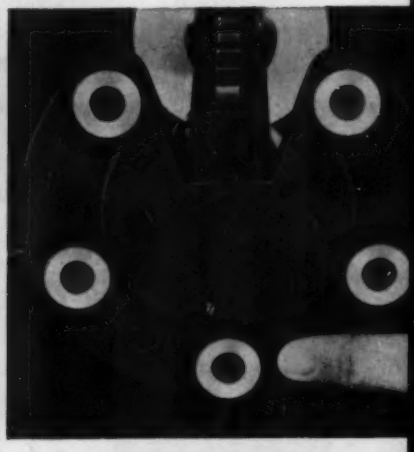
& Sharpe's new Hite-Set tool you can buy!"

Design, Brown & Sharpe, Industrial Products Division

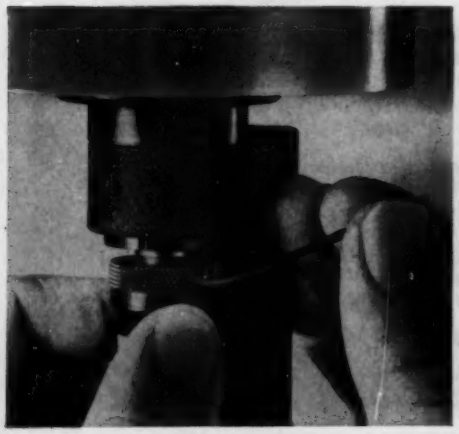


"Look at this easy-reading head! It's a full 4" across — the biggest in the business. Reads directly in tenths, and spreads the divisions out so you can see them all the way across a big surface plate or machine.

"See the accuracy you get — within .000050" over the entire range of blocks, and highly repeatable! You read off a small parallel surface, moving up and down, not, as in some tools, off a large rotating disk.

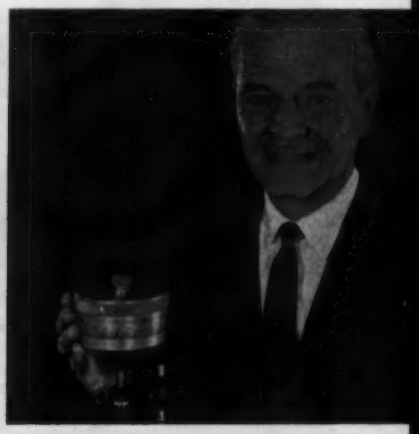


"Base is solid as a rock! These five big buttons are hardened and lapped to better than Class A Gage Block accuracy, so your Hite-Set won't tilt. (If it does, you need a new surface plate from Brown & Sharpe!)



"See the simple zero adjustment — You don't have to take the head off to set to "zero". Another feature: Repairs are economical; damaged Hite-Set blocks are replaced individually — you don't need a whole new column.

"Companion pieces to do any job better are available from Brown & Sharpe. Super Hite-Chek® (a) transfers heights in .000025". 9" Riser Blocks (b) extend range at low cost. B&S Black Granite plates and flats provide a perfect base.



"Finally, you pay less for Hite-Set accuracy. When the range of heights you want to measure is considered, you will find that combinations of Brown & Sharpe Hite-Sets and Riser Blocks usually cost less per inch of range than competitive tools."

Try Hite-Set, and you'll never settle for less! Ask your B&S distributor to show you this tool and the complete line of B&S inspection and gaging equipment. Brown & Sharpe Mfg. Company, Industrial Products Division, Providence 1, Rhode Island.

Brown & Sharpe PRECISION CENTER

CIRCLE 190 READER SERVICE CARD

New ARMSTRONG Swivel Pad can't come off

Now ARMSTRONG deep throat "C" Clamps have the new (Pat. apd. for) ARMSTRONG Ball-joint Swivel Pad. This "C" Clamp pad, developed by ARMSTRONG Engineers, is tougher than any on the market. Rigorous testing in our own plant first proved this fact, and field tests in factories throughout the country have confirmed our own test results.

Here's Why it's STRONGER . . .

The lip of the opening in the ARMSTRONG Ball-joint Swivel Pad is undercut so that when the ball of the screw is inserted, and the lip is permanently forced down, a solid steel wall is formed, inside the pad cavity, completely encircling the ball.

This wall of steel makes it impossible for the pad to come off the screw during normal use. In fact, our tests have proved that it is virtually impossible to intentionally knock the pad off with a hammer —yet the pad is free to swivel through an arc of approximately 40°.

Call your ARMSTRONG Distributor

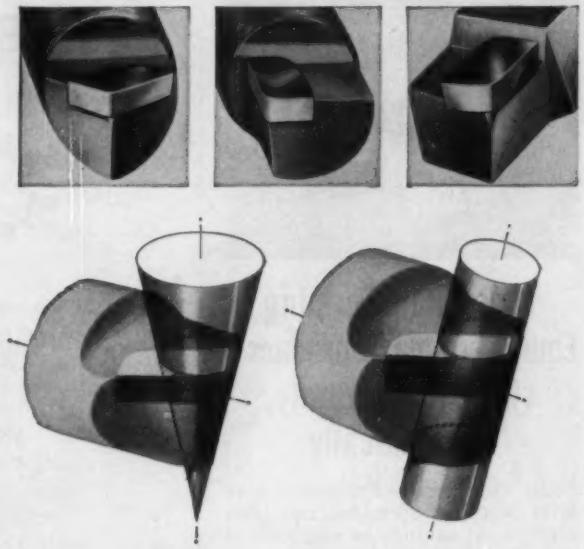
Your ARMSTRONG Distributor can offer delivery from stock on this "400-Series" deep throat, drop-forged "C" Clamp with the new Ball-joint Swivel Pad. He also carries in stock the other styles of clamps in the ARMSTRONG Line—the broadest line of drop forged "C" Clamps.

ARMSTRONG BROS. TOOL CO., 5215 W. ARMSTRONG AVE. CHICAGO 46, ILLINOIS

special report from Fair Street on cutting tool geometry

ONE OF A SERIES

how proper cone relief grind greatly increases single point tool life... at maximum speeds and feeds



NEW MICROPOINT TOOL GRINDER MAKES IT POSSIBLE

In a previous report the importance of relief angle and its bearing on tool life was discussed. Just as important as the relief angle is the manner in which this angle is generated under the nose radius.

There are two grinding methods used to generate the relief angle on a single point cutting tool. One method is called cone relief or constant relief grind. The other method is called cylindrical relief or variable relief grind.

WHAT CYLINDRICAL GRIND IS

Cylindrical or variable relief grind produces a varied relief under the tool point. The relief or clearance varies in such a manner that the most important part of the tool, the tool point, has excessive clearance.

Because of excessive relief under the tool point this all-important point is not provided with proper backing to support the cutting edge. Hence, the unsupported cutting edge quickly chips, dulls and breaks. Accuracy is lost and tool life is greatly reduced.

WHAT CONICAL GRIND IS

Cone relief or constant relief grind, on the other hand, provides uniform clearance around the entire profile of the cutting edge of the tool. Because of constant relief under the nose radius, the tool point receives maximum backing or support at this, the most critical point of the entire machining process. Adequate support at this critical point under the nose radius can increase tool life significantly and will provide better control over accuracies and surface finish. Cone relief grind is the type of tool point geometry made entirely practical by the DeVlieg MICROPOINT Tool Grinder, a new single point tool grinder developed by the DeVlieg Machine Company.

Careful study of the geometric projections above will prove that MICROPOINT is capable of producing a geometrically perfect radius. Further study of the cylindrical grind diagram will show inherent weaknesses of the elliptical form produced on conventionally ground tools.

CONCEPT OF CONE RELIEF IS NOT NEW

The superiority of cone relief grind over cylindrical relief grind has long been known. However, using standard offhand grinding machines, it was practically impossible to capitalize on a conical relief's many advantages. Even today, the DeVlieg MICROPOINT Tool Grinder is the only grinder available that can control by simple direct reading dials a conical or constant relief angle and through its unique and rigid design, can repeat the same relief angle time after time on tool after tool without corrective adjustment.

ANYONE CAN USE MICROPOINT

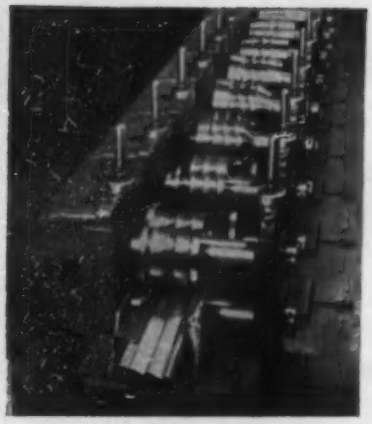
Another major advantage of the MICROPOINT system of single point tool grinding is the fact that no special skill is required on the part of the grinding machine operator. Inexperienced operators can quickly master MICROPOINT. Control of nose radius, radius tangencies, relief angles and quality of the cutting edge and maintenance of offset dimensions is automatic.

For further information about the DeVlieg MICROPOINT Tool Grinder, please write or visit DeVlieg Machine Company, Fair Street, Royal Oak, Michigan.

DeVlieg

MICROPOINT® TOOL GRINDER

for grinding all sizes and types of round and square shanked tools



Yoder Roll-Forming Equipment mass-produces shapes accurately, economically

Yoder Roll-Forming Equipment, even with part-time operation, can effect significant savings in many metal working applications and industries. Shapes, simple or complex, can be quickly and economically produced the Yoder way from a wide variety of flat-rolled coated or uncoated stock ... in thickness up to ¾ inch ... in speeds up to 50,000 feet per day.

Yoder engineers flexibility and precision into metal forming operations. For example: many basic shape modifications, such as coiling, welding, notching, ring-forming, perforating, and cutting to length can be simultaneously accomplished with little or no additional labor cost.

Yoder also makes a complete line of Rotary Slitters and Pipe and Tube Mills. Profit from Yoder's years of engineering and service experience, contact your local Yoder representative or send for the Yoder Roll-Forming Manual.

This fully-illustrated 88-page book clearly discusses every important aspect of Yoder Roll-Forming Equipment and methods ... it's yours for the asking!

THE YODER COMPANY
5519 Walworth Avenue • Cleveland 1, Ohio

YODER COLD ROLL FORMING MACHINES

LETTER from the PUBLISHER

A Major Breakthrough

When we published the first report on numerical (tape) control of machine tools ever to appear in the business press (see AM/MM, October 25, 1954), very few people recognized the revolutionary impact this new development would have on manufacturing methods and costs. Yet the coming of numerical control is as significant technologically as was the coming of the electric motor. Just as the motor has multiplied by many times what a man can do by muscle alone, so numerical control extends man's skill.

For short runs . . .

Primary application of numerical control is in short-run production. Since it virtually eliminates tooling, jigs and fixtures, it greatly reduces the first cost of a job. Because it lowers the break-even point and offers predictable production rates, it also sharply cuts the size of the inventory you must carry. To manufacturers beset by serious foreign competition (especially medium-size and small shops, and those industries, such as the machine tool industry, where the labor content of the product is high), numerical control represents a major technological breakthrough.

Over 50 articles . . .

In line with our policy of keeping you thoroughly and accurately informed about all important new developments, AM/MM has published more than fifty major articles on numerical control since that first article appeared over six years ago. Our August 8, 1960, issue contained a complete bibliography of those articles. The articles themselves are available in a paperbound volume at $2.50. If you would like a copy, drop me a note.

George Reppert

FOURTH DAY DOWN . . . Until Cimplus took over!

Here's an actual case history of another plant that has discovered the remarkable qualities of rust-controlling CIMPLUS, transparent grinding fluid of the famous CIMCOOL family. (Company name on request.)

FIELD SERVICE REPORT

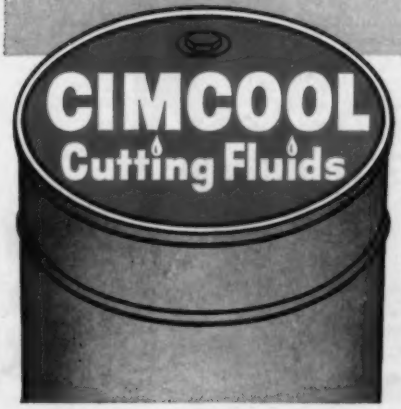
The job was grinding cast iron machine tool parts on three rotary surface grinders with an 1800 gallon central cutting fluid system.

The coolant they had been using had let the sludge cake up and clog up the lines and they had been shut down for four days. Then we installed Cimplus at 100 to 1 dilution and the problem was solved.

Since Cimplus took over, they've had no sludge trouble at all. The swarf and grit settles nicely for them, but it doesn't cake. They're also real pleased with the rust prevention on the cast iron parts that Cimplus gives them.

Kent Reece
N. Y. Office

Page 2



FOR 100% OF ALL METAL CUTTING JOBS

Production-proved products of The Cincinnati Milling Machine Co.

CIMCOOL 52 Concentrate — The pink fluid which covers 85% of all metal cutting jobs.
CIMPERIAL® — Newest in the famous, industry-proven line of CIMCOOL® Cutting Fluids.
CIMPLUS — The transparent grinding fluid which provides exceptional rust control.
CIMCUT Concentrates (AA, NC, SS) — For every job requiring an oil-base cutting fluid.
ALSO — CIMCOOL Tapping Compound — CIMCOOL Bactericide — CIMCOOL Machine Cleaner.

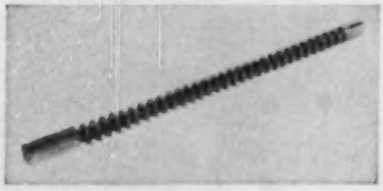
For full information on the complete family of CIMCOOL Cutting Fluids, call your CIMCOOL Distributor. Or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

®Trade Marks Reg. U. S. Pat. Off.

CUT A KEYWAY IN 1 MINUTE
WITH A
Minute Man®
KEYWAY
BROACH KIT

With one, you can cut a keyway in one minute for **as little as one cent** by hand with an arbor press. Twenty different kits available from stock for keyways from 1/16" to 1" in any bore from ¼" to 3".

Save Time With
STANDARD STOCK SQUARE BROACHES



Starting with a round pilot you can finish an accurate square hole in one pass in less than one minute. Hexagon and round broaches also available.

The duMont Corp., Greenfield, Mass.
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Company.....
Address.....

duMont

LETTERS

to the editors

330 W 42nd St, New York 36, NY

Electric Discharge

Dear Sirs:
On your "Talking Shop" page (*AM/MM*—Jan 9 '61, p95), you have an item on electric discharge machining, and you mention that the Elox Co is manufacturing electric discharge machines in the United States.

Could you furnish the address of this company?

B Y Morris
Enka, NC

The address is: Elox Corporation of Michigan, 1830 Stephenson Highway, Troy, Mich—Ed.

Monorail

Dear Sirs:
In your "Names in the News" section (*AM/MM*—Oct 17 '60, p141), you carried an article about George Papen of Lockheed Aircraft Co.

We thought we had better bring to your attention the fact that the Century 21 Exposition's monorail is being built by Alwac International and not by Lockheed.

Lockheed and Century 21 did negotiate in 1959 for a monorail system, and Lockheed was at one time named prime contractor. However, the agreement was dissolved early in 1960.

The Century 21 Exposition will take place from Apr 21 to Oct 21, 1962.

A Swensson, press coordinator
Century 21 Exposition
Seattle, Wash

Beryllium Copper Not Beryllium

Dear Sirs:
Subject: Cover photo and story on "Contour machining beryllium" (*AM/MM*—Jan 9 '61, p69).

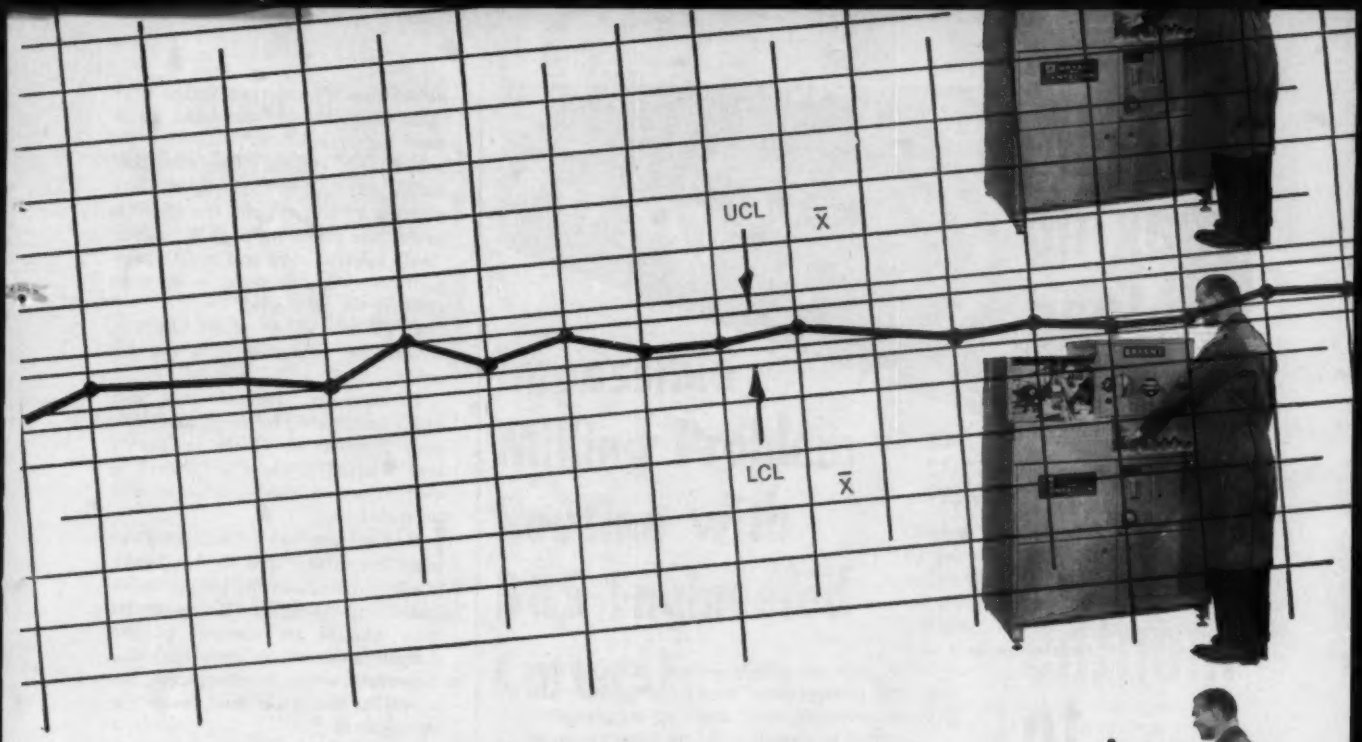
As we are engaged in the precision machining of pure beryllium and have invested in evacuation systems for the removal to toxic dust to the tune of approximately $500,000, we feel that the subject article is in error in many ways.

1) Pure beryllium *is* highly toxic and requires the use of high-vacuum equipment for the removal of chips and dust.

2) Beryllium when annealed, does not change its hardness char-

SHOPMATES

N. Jarvis



TEST CURVES LIKE THIS PROVE OUT BRYANT GRINDERS

The test curve above is typical. It shows the average size variation of the I.D. in a run of sample parts ground to customer specifications on a Bryant Internal Grinder. From this curve and other data, Bryant engineers evaluate the machine's *long term* precision capabilities, using mathematical laws of probability. Result: a job-engineered machine, tested under actual production conditions — *proved out* by statistical quality control methods. Logical reasons why a Bryant Production Internal Grinder is best suited to maintain the required quality standards in *your* plant. Contact your nearest Bryant or Ex-Cell-O sales representative for full details.

This Model "B" Centalign® provides quick changeover and high precision on short or long production runs of small workparts.

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Some of the companies are: A. B. Dick, International Harvester, Kaiser Willys, White Motors, R.C.A., Sperry Rand, etc.

Licensees of Templet are assured of uninterrupted use of this unique tooling process. T. I. P. is protected by 44 patents granted and pending throughout the world.

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acteristics. The article states that "the billets were annealed to a dead soft condition."

3) After stating that the material was highly toxic at the beginning of the article, the caption under the photo on page 70 states, "only routine care and health precautions were necessary in machining this material."

4) In the color photo on the cover, the material is a copper color.

To sum up: Are you sure you are not referring to beryllium copper? If so, as beryllium copper is less than 2% pure beryllium, a correction on this article should be published.

If you are truly referring to pure beryllium, and if it is being machined without the proper safeguards at Douglas - El Segundo, they should be warned of the danger involved in machining the material without complete removal of the toxic dust from the atmosphere.

Ronald R. Murray, *sales manager*
American Beryllium Co
A Division of Visioneering Co, Inc
Sarasota, Fla

Reader Murray is correct in every point, except for his comment that the article "is in error in many ways."

It is wrong in only one way—it says beryllium where it should say beryllium copper—but it does repeat this fault a number of times.

This unfortunate error developed in transmission of the information, and we failed to catch it prior to publication. We apologize—Ed.

"Nice to dine out. I get so tired of living from can to mouth."

CALENDAR

Society of Automotive Engineers —National Automobile and Production Meetings, Mar 13-17, The Sheraton-Cadillac, Detroit, Mich.

American Society for Metals — Western Metal Show, Mar 20-24, Pan-Pacific Auditorium, Los Angeles, Calif.

Pressed Metal Institute — Spring Technical Meeting, Mar 22-24, Belmont Plaza Hotel, New York, NY.

American Machine Tool Distributors Association — Spring Meeting, Mar 23-25, Hotel Mark Hopkins, San Francisco, Calif.

Society of Automotive Engineers —National Aeronautic Meeting & Display, Apr 4-7, Hotel Commodore, New York, NY.

American Welding Society — Annual Meeting and Welding Show, Apr 17-21, Commodore Hotel and Coliseum, New York.

National Institute for Disaster Mobilization — Mutual Aid and Disaster Control Seminar, Apr 18-20, Shamrock Hilton Hotel, Houston, Texas.

American Society of Mechanical Engineers—Metals Engineering Conference, Apr 23-26, Penn Sheraton Hotel, Pittsburgh, Pa.

Metal Powder Industries Federation — Annual Meeting and Powder Metallurgy Show, Apr 24-26, Hotel Sheraton-Cleveland, Cleveland, Ohio.

American Institute of Mining, Metallurgical, & Petroleum Engineers—High-Temperature Materials Conference, Apr 26-27, Carter Hotel, Cleveland Ohio.

National Screw Machine Products Association—Annual Meeting, Apr 29-May 3, Summerset Hotel, Boston, Mass.

American Foundrymen's Society —Castings Congress and Exposition, May 8-12, Brooks Hall and Civic Auditorium, San Francisco, Calif.

National Industrial Production Show of Canada — May 8-12 Canadian National Exhibition Park, Toronto, Ont.

Impossible Milling Problem Routine with B&S Engineered Cutters!

B&S CUTTER PERFORMANCE

Original attempts to produce the piece by grinding from solid and by other methods were unsatisfactory. B&S Cutter produced pieces for a fraction of the cost of grinding. Part quality and lead accuracy exceeded requirements.

EXTERNAL THREAD

PART: Locking shaft for hydraulic gate

MATERIAL: No. 135 Nitralloy heat treated to 295 BHN

MACHINING TIME: 45 minutes

CUTTER: B&S, 4P Acme Thread Milling Cutter

SPEED: Part 4/5 RPM, Cutter 96 RPM.

LENGTH OF CUT: 11 11/16"

PRODUCTION: 4 Pieces—3 hours of close tolerance, uninterrupted cutting per sharpening

B&S CUTTER PERFORMANCE

Previously, this internal thread was tapped with unsatisfactory results. B&S Cutter lowered time and cost of production and maintained a degree of part quality, uniformity and lead accuracy considered impossible.

INTERNAL THREAD

PART: Ram shaft for hydraulic gate

MATERIAL: AISI 410 heat treated to 210-250 BHN

MACHINING TIME: 45 minutes

CUTTER: B&S 6P Acme Thread Milling Cutter

SPEED: Part ½ RPM, Cutter 200 RPM

LENGTH OF CUT: 3 15/16"

PRODUCTION: 3 Pieces—2¼ hours of close tolerance, uninterrupted cutting per sharpening

NOTE:—

In addition to the production benefits engineered into every Brown & Sharpe Milling Cutter—Cutter Service Shops in strategic locations and cutter engineering in your plant are two other EXTRAS to expect when you specify B&S.

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Cutting Tool Division
Brown & Sharpe Mfg. Co.
Providence 1, Rhode Island

9 questions you should ask about numerical machine tool controls

1

Has the system, through actual use, proven to be a money saver?

Many new controls on the market today have yet to be installed on their first customer application. However, Hughes numerical positioning controls have been successfully operating in customer plants for over a year and a half! One typical Hughes customer was able to cut tool costs by $3000 and reduce lead time by 50% on a run of 50 missile parts.

2

Is it competitively priced?

Many people are surprised that Hughes systems, with all their advantages, are often priced lower than competitive units.

3

How many machine axes can I control?

Hughes provides either two or three axis controls – in the same cabinet. And, with the Hughes system, you can purchase a two axis control now, and add the third later.

4

Are special skills required to prepare the tapes and operate the machine?

Not with the Hughes system. Anyone familiar with general machine shop practices can prepare the tapes and operate the machine after only two days training!

5

Can I get high accuracy – and, is that accuracy repeatable?

Hughes two-axis controls offer you repeatable accuracies of ±0.0002 inch with a resolution of ±0.001 inch. Adding the third axis, repeatable depth accuracies of ±.0005 with a resolution of ±0.001 inch can be obtained.

6

Will I need a great deal of service after sale?

Maybe you've heard about numerical control systems that require a lot of service. Not so when you specify a Hughes Numerical Machine Tool Control. Customers report that "up time" is over 95% – after a full year of operation!

7

Is the system transistorized for maximum reliability?

The Hughes Transistorized System is much less sensitive to vibration, shock and temperature fluctuation. Result: with Hughes transistorized circuitry you get higher reliability and minimum maintenance.

8

Is the tape reader fast and reliable?

Mechanical tape readers have two inherent disadvantages: they are relatively slow and they tend to deform the tape holes. Not so with photo electric tape readers – the type used on Hughes controls. They're extremely fast (eliminating need for costly electronic storage) and they do not injure the program tape.

9

Does the manufacturer have a reputation for standing behind everything sold?

Hughes gets an emphatic "yes" to this question. Hughes has built a reputation as a *world leader* in advanced electronics and has a world wide service organization.

Find out more about how Hughes Numerical Controls

can increase your profits. Write, wire, teletype (TWX INGL 4117) or call direct: Hughes Industrial Control Systems, Dept. No. 92-21, P.O. Box 90904, Los Angeles 45, California. For export information please write: Hughes International, Culver City, California.

CREATING A NEW WORLD WITH ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
INDUSTRIAL SYSTEMS DIVISION

SPOT NEWS...

- **Numerically controlled automatic wiring machine built for IBM** by the Gardner-Denver Co is the first of an order for 45 such machines. Each machine will replace 45 people on three operations in the wiring of SMS chassis panels. Machine time is 6 to 7 seconds per wire versus 2 to 2½ minutes for manual assembly. Machine receives data from punched cards, then cuts, forms, and assembles each wire, then wire-wraps end to terminal pins. This is reported to be the largest block of similar machines ever ordered by IBM.

- **Russia "may be as much as 10 years ahead of us"** in development of the electro-spark ("underwater lightning") metalforming process, according to informed industry sources, and may already have equipment at work on the production line. For a rundown of how U S companies are progressing with this phenomenal new forming method see p80.

- **New high-strength engineering plastic, "Celcon," is an acetal copolymer** developed by Celanese Corp of America as a replacement for such metals as die-cast zinc and aluminum, and brass, copper and steel. It is hard, stiff, dimensionally stable, lightweight, resists abrasion and environmental attack. Celcon, while it competes with Delrin and Lexan, has somewhat different properties.

- **Exports by British machine tool industry set a record in 1960.** Export shipments of over $82 million marked an increase of 22% over the 1959 figure. Increased sales to India and Australia accounted for most of the gain; sales to France fell off, and business with Japan and the U S barely held its ground. Mechanical press builders cornered the greatest share of the increased business.

- **Japan may accept Hungarian offer to swap machine tools for Japanese rayon.** Right now a team of Japanese officials (from the Osaka area) is in Hungary to conclude negotiations, which involve at least 230 machine tools. Observers say that many Japanese machine-tool builders favor importing Communist machines, because they use, like Japan, the metric system. A successful deal, they say, will help Japan get rid of surplus rayon, also benefit small machine shops in great need of machine tools.

- **New free-machining Type 303 stainless has about one-half the sulfur content** of regular 303, also contains 0.70% aluminum. Lower sulfur content reduces harmful effects on fabrication and performance of finished parts; added aluminum makes the alloy at least as machinable as regular 303, according to Universal-Cyclops. Called Uniloy 303MA, it is weldable and approaches Type 304 in resistance to nitric acid.

- **Scandium, a rare-earth metal, may find use as an alloying element** in heat-resistant alloys. Soviet metallurgists claim that scandium diboride, produced by powder metallurgy techniques, has a melting point, hardness, and thermal expansion very close to those of chromium diboride, but is 30% lighter. Thus, say the Russians, scandium diboride would make a good subtitute for chromium as a component of light heat-resistant alloys.

- **A technical conference on high-temperature materials** will be held at the Pick-Carter Hotel in Cleveland April 26-27, 1961. Sponsored by the Cleveland Section of the American Institute of Mining, Metallurgical and Petroleum Engineers, the conference will emphasize materials for use at temperatures above 1600 F in aircraft, missiles, and nuclear reactors. Fee is $15 for AIME members, $20 for non-members. For advance registration forms, write D J Berger, Clevite Research Center, 540 E 105 St, Cleveland 8, Ohio.

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point-to-point or continuous path positioning

dial-in control of 2 axes, or tape control of 2, 3, or 4 axes

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all drive screws in center of guideways for best accuracy, least wear

tape is read during positioning; no delays

simple switching from tape to pendant controls

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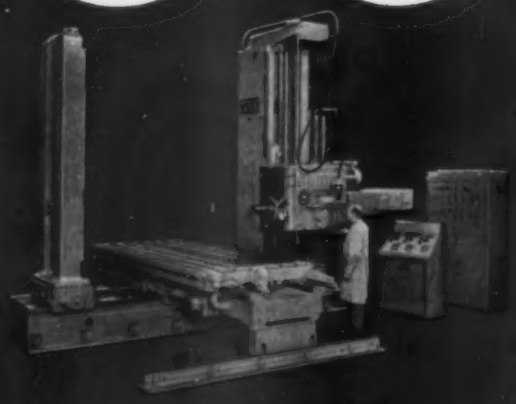
wide range of sizes, both table or floor type



14 reasons to consider tape-controlled Gilberts

Summarized here are the main reasons you should consider Cincinnati Gilbert's numerically-controlled 4" and 5" horizontal boring mills. We suggest a letter or phone call for complete information—or, better yet, a visit to the plant to see an actual demonstration. The Cincinnati Gilbert Machine Tool Co., 3366 Beekman Street, phone Kirby 1-4815, Cincinnati 23, Ohio.

GILBERT

WASHINGTON...

Defense reappraisal . . .

Preliminary conclusions from the Kennedy administration's intensive reappraisal of U S defense posture are being put together in time to show up as amendments to the Eisenhower military budget for fiscal year 1962. The most far-reaching inquiry of its kind since Eisenhower's controversial military "new look" of eight years ago, it is aimed at reshaping basic policies in line with a new assessment of the military threat and a new evaluation of how to meet it.

Kennedy's new look in defense is expected to show a shift in basic deterrent strategy. This would place greater emphasis on readiness for limited wars and on making nuclear retaliatory forces less vulnerable to attack. It would mean increased spending on the wide range of army weapons and equipment, transport aircraft (the Pentagon has already ordered 53 additional planes), and possibly on tactical fighter planes and naval transport. On the strategic weapon side, the new policy will stress Polaris and Minuteman missile systems.

Military procurement speedup . . .

The Pentagon's current round of accelerated contracting adds up to $1.4 billion. This includes $597 million on the five additional Polaris submarines and $125 million on transport planes. In addition, $650 million worth of new contracts will be awarded two to three months earlier than originally planned.

Aid to small firms . . .

Defense Secretary McNamara has ordered an intensified effort to channel more military contracts to small business. Organization of the Pentagon's small business policy office has been overhauled; the operation will be run by Civil Service career experts in military procurement rather than by political appointees, as has been the case heretofore.

The services have been directed to limit the use of non-competitive, sole-source contracting whenever possible, to spur more orders to smaller firms. They have also been ordered to "find greater opportunities" for small business contracting set-asides and to "encourage" prime contractors to "increase competitive opportunities" for small firms in subcontracting work.

Import outlook . . .

Government experts are predicting a slight decline in overall imports this year. The un-official forecast is for a $14 billion import level in 1961, $600 million below last year. The major factor in the forecast: the domestic recession. The general rule-of-thumb is that in times of recession, imports tend to drop; in times of economic boom, imports usually rise. There are exceptions, depending on country and product.

Washington officials also believe the economy of Western Europe has nearly peaked, that the boom will begin levelling off in West Germany and Japan. They also cite rising labor costs overseas which will jack up prices of many import goods.

But some industry estimates of overall imports exceed the government forecasts. The National Foreign Trade Council, for example, predicts about $15 billion in imports this year, slightly higher than the 1960 rate.

Machine tool import situation . . .

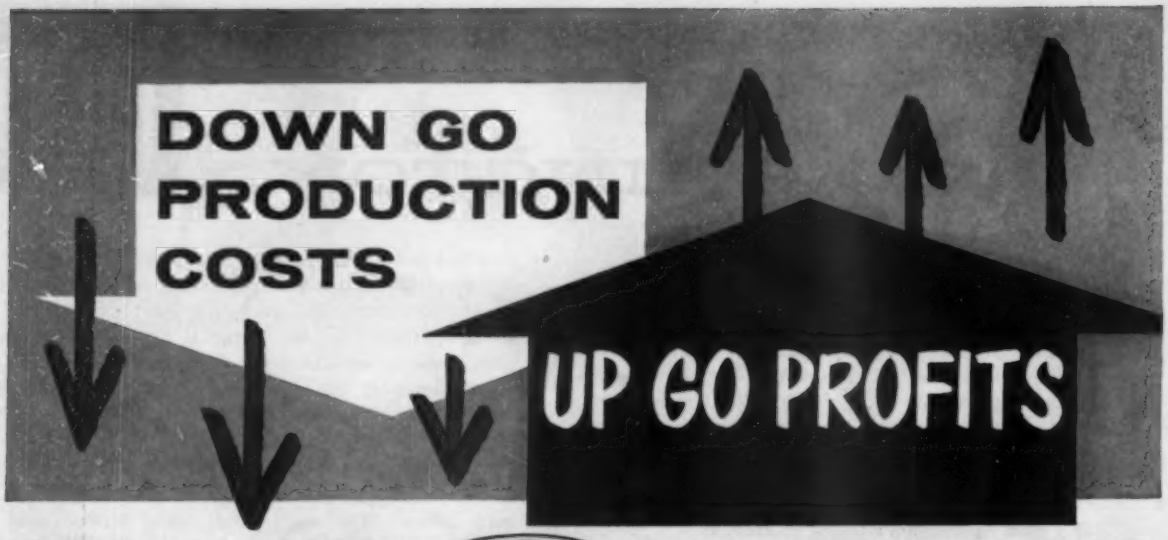
In terms of machine tool imports (which the government experts do not get into in detail), NMTBA predicts a heavier rate this year than last year. Commerce Department figures show imports of $28 million in "metal-cutting and metal-forming" machines for the first nine months of 1960, $6 million over the comparable period in 1959. But NMTBA thinks the statistics are incomplete, that imports are running at an even higher volume. Machine tool exports continue to run at a rate of at least three times the import volume.

As the industry views it, machine tool imports to the U S have risen to new highs at a time when demand in Western Europe, Japan, and in some underdeveloped countries were at an all-time high, and that any downturn in the Western Europe or Japanese economy would spur foreign producers to try to capture an even larger share of the U S machine tool market.

Automation impact . . .

Organized labor is worried that automation will take a deep cut into industrial jobs later this year—if and when the recession ends. Union leaders fear that thousands of laid-off workers will not be recalled when business turns up.

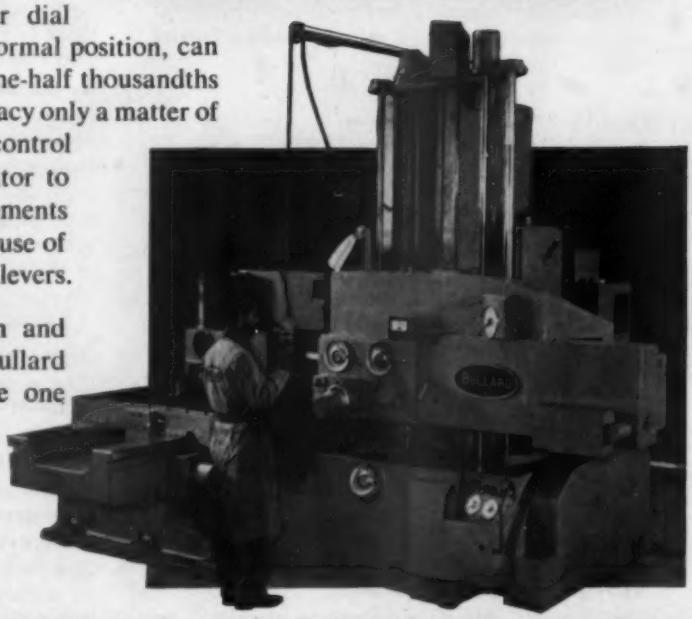
A new automation survey by the House Labor Committee shows what's behind labor's concern. It reports total numbers of jobs permanently lost in key industries through the introduction of automated equipment: autos, 160,000; steel, 100,000; electrical manufacturing, 80,000; chemical, 13,000; coal, 200,000; oil, 10,000.



With the NEW BULLARD DYNAMILL H.B.M.

The controls, which have made it possible for Dynamill to reduce non-productive positioning time to a minimum, feature variable traverse rates recorded on large, clock-type dials, and controlled by Bullard's remote control pendant.

Head, table, saddle, and spindle each have a separate three-pointer dial which the operator, from his normal position, can easily read to an accuracy of one-half thousandths of an inch with further accuracy only a matter of simple interpolation. The remote control pendant allows the operator to traverse and position all elements under power without the use of handwheels, cranks or levers.



These and many other design and construction features of the Bullard Dynamill H.B.M. make it the one machine you

must investigate before buying any horizontal boring machine.

THE BULLARD COMPANY BRIDGEPORT 9, CONN.

DETROIT...

A Kennedy-session?

No one can blame President Kennedy for the recession—he inherited it. But Detroit automakers are concerned about his emphasis, realistic as it may be, that this country may be in a serious economic slump.

As a result, top factory officials have suddenly embarked on an unprecedented series of nationwide dealer meetings. For example, Chevrolet General Manager Edward N Cole is losing no opportunity to tell anyone and everyone that a 7-million-unit sales figure for 1961, including imports, still looks good to him.

Mr Cole, who is an engineer by trade, may be more useful as an economist than the professionals. It is for this reason: The doleful talk concerns the marginal worker with little seniority and less skill. Sales fall off. He is laid off, and car building areas throughout the country become eligible for Mr Kennedy's food-stamp plan.

Newspapers headline this very real fact, and the reader who has just cashed his $800 monthly salary check postpones the purchase of a needed new car. So, with apologies to George Romney, who first pinpointed this fact, a recession born of conversation sets in.

Production facts . . .

According to available statistics, February production was at its lowest ebb since 1952. It was less than half the pace set last year at that time, and the doleful record repeats a similar January performance.

Forecast for the quarter has now been shaved to 1,200,000 units. At this rate the model-year production will barely exceed the annual march to the junkyard of worn-out cars. A spring sales surge is still hopefully expected (as witness Mr Cole's optimism), but it will take an intangible called confidence in the economy.

Is it price?

According to the statistical agency, Ward's Automotive Reports, more cars are sold in the $2401 to $2500 price range than any other grouping. A suggested list of $1601 to $1700, where presumably Ford's forthcoming Cardinal would fit, accounts for an infinitesimal fraction of as many cars.

Even more interesting is conflicting information on the scheduled introduction for this small-sized (99.5-inch wheelbase), but mighty, dollar-wise gamble on Ford's part. Tooling orders—for the most part completed—indicate availability as a 1962 model.

The picture is clouded, however, because of the international character of the project. Components will be built in Germany, England and the United States, and a basically similar car will be assembled in even more locations. It could be, for example, introduced for the European Common Market as a 1962 model and delayed in this country for another year.

Still another conjecture is that confusion on the timing is being deliberately fostered by Ford to harass Chevrolet. It is well known that in addition to a counterpart to Ford's forthcoming middle-sized compacts—the Canadian X and Y—Chevy has in the works a baby car. If Ford sells the idea that the Cardinal will not be marketed in the U S until the 1963-model season, then Chevy could already be lulled into a welcome delay. Ford's next move is obvious and already, this corner believes, committed.

What's in a name?

A few telephone calls disclosed the fact that, on the average, Detroit spends 20 cents per piece for the chrome script that is liberally splashed on fenders, deck lids, hoods and even door mouldings of cars.

Just counting the average of a model designation on each of two front or rear fenders, the bill comes to a staggering $4 million. It probably doubles, should one compute actual usage.

What is the justification? Well, sadly, part of it is a play upon the vanity of the buyer. Although few non-Pontiac owners know the difference between a Catalina and a Bonneville, those that paid the $500-plus extra for the latter do, and expect their extra expenditure to be duly recorded.

Another purpose is to facilitate ready identification on used-car lots. Presumably a used-car salesman (or buyer) could check whether the merchandise is an Olds 88 or 98 by using a tape measure. Of course, the 98 cost more new and is therefore worth more used. Script on the fender is the easy way out.

Another interesting facet disclosed by this investigation is that sometimes one name is not enough. Olds found that "88" alone did not satisfy, so it added the adjective "Dynamic". Olds buyers are thus lulled into the belief that there is no such thing as an austere Oldsmobile. So, too, are their neighbors.

—Don MacDonald

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- Special Purpose Machines
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COOPERATIVE TEAMWORK MAKES THE DIFFERENCE

Through every phase of the construction of a Greenlee transfer machine, Greenlee engineers maintain a close contact with you, the customer. They are strong on the buyer's viewpoint . . . know what cost-conscious management wants. They stay on the job from the time of initial planning until your machine is operating at full efficiency. This last phase—the proving out period—is especially important. Greenlee men are extremely helpful in bringing your machine up to full production . . . training your operators to keep it producing profitably. Call Greenlee. Let them show you how cooperative teamwork can benefit you.

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AIRCRAFT and MISSILES...

TRENDS

High-energy-forming study . . .

The National Aeronautics and Space Administration has awarded Republic Aviation Corp, Farmingdale, NY, a study contract for investigation of electrical discharges for forming high-strength metals.

Republic's manufacturing research department says the study will compare the efficiencies of two basic techniques in shaping of stainless steel and aluminum alloys.

The first technique—"spark forming"—deforms metal by shock waves created in a liquid medium. (See page 80.)

Second technique—"inductive repulsion forming"—is also known as magnetic forming. An induction coil is placed near the workpiece and insulated from it; during the electrical discharge, opposing currents in the coil and metal produce a magnetic force which repels and deforms the metal away from the coil.

The contract, for $22,900, was received from Marshall Space Flight Center, NASA's facility at Huntsville, Ala.

Republic's work in the use of electrical energy for metal forming dates back to 1959 when the company developed an experimental device known as the "spark bomb" (*AM*—Oct 19 '59, p123).

X-Ray inspects rocket motors . . .

The Navy is using a 10-million volt radiographic linear accelerator at its Concord, Calif, ammunition depot to inspect the solid-fuel rocket motors of Polaris, Minuteman, and Skybolt missiles.

Designed and built at Varian Associates' Palo Alto plant, this giant X-ray machine searches missile components and solid fuel for flaws, cracks, and voids.

Heart of the machine is a powerful "electron gun" which aims a pulsed barrage of electrons at a gold target, causing it to emit X-rays so powerful that 5-ft-thick fuel sections can be radiographed in a matter of minutes. Flaws as small as a few hundredths of an inch in diameter can be detected.

Solid-fuel breakthrough . . .

Successful firing at —75 F of a rocket motor containing some 3500 lb of an advanced new solid propellant promises significant operational advantages for tactical missiles. Such missiles would operate reliably under severe temperature conditions without requiring special heating or handling equipment.

Manufactured and tested by Rocketdyne at McGregor, Texas, the 38-in.-diameter, 7-foot-long rocket motor is believed to be the largest solid-propellant rocket motor ever cycled and firing at such a low temperature.

According to T E Myers, Rocketdyne VP, "This breakthrough in solid propulsion is a result of Rocketdyne's successful development of a unique family of propellants called Flexadyne." Based on an advanced polybutadiene fuel-binder, these new propellants have improved resistance to cracking or tearing at extremely low temperatures.

Nike-Zeus production . . .

The Army is intensifying its fight for money to begin production of the Nike-Zeus anti-missile system. Up to now, the policy has been to defer tooling-up until the system has been tested out.

An operational test of the system, in which Zeus will be pitted against an ICBM target fired at Kwajalein in the Pacific, is not scheduled until some time in 1962.

Now, however, the Army seems to be picking up support to get ready for production and to start building the long-lead-time electronic components of the system. Democratic Congressional leaders are pushing the plan.

There are no production funds in Eisenhower's FY 1962 defense budget. Approval of the Army's plea would require the Kennedy administration to add some $200 million to next year's appropriation request.

Westinghouse Electric and Douglas Aircraft are major contractors on the Nike-Zeus system.

Nuclear rocket engine . . .

The AEC-NASA Nuclear Propulsion Office has invited proposals for research and development of a nuclear rocket engine.

The selection, although based on a company's capability to carry out the entire nuclear engine development program, will result initially in a contract for the first phase only. This phase will include assistance to the Los Alamos Scientific Laboratory in the conduct of the Kiwi-B test program, and performance of certain research and development tasks on a variety of non-nuclear components.

"The fabulous '60s, with tremendous technological advances predicted, will require this type of perfectionist precision tool . . . and, son—

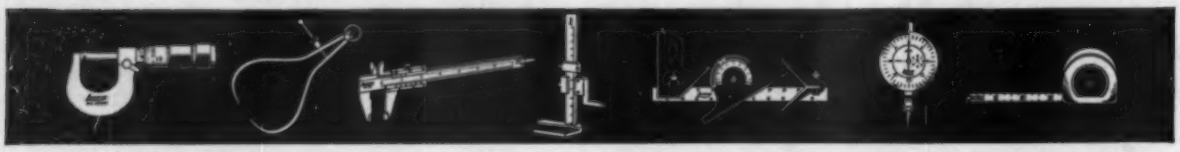
only Lufkin offers you a decimal radius gage!"

This unique radius gage is an excellent example of why Lufkin is the new leader in precision tools. It is designed to save the craftsman time and effort . . . to give him greater accuracy with readings from .010 to 1.000, and no burrs to throw him off.

Hardened stainless steel blades, too, for a lifetime of accurate service. And the holder for this No. 75 gage is 4½" long, reaches into small, out-of-the-way places. Adjusts over 180° arc to keep blade edge perpendicular to surface measured.

Durable vinyl case holds blades in individual pockets, makes selection fast and easy.

See your industrial distributor. He knows precision tools and can show you how Lufkin leads in design and craftsmanship. His stock is maintained to fit your needs. LUFKIN, Saginaw, Mich.



MACHINE TOOLS...

P&W to take any make in trade-in

You now can trade in any make of machine tool when you purchase a new Pratt & Whitney machine. You are not restricted to old P&W machines in securing a trade-in allowance.

This is the core of a bold program to stimulate replacement of old machines with new inaugurated by Pratt & Whitney Co Inc, West Hartford, a major subsidiary of Fairbanks Whitney Corp. This is the first time that such a sweeping program has been put into effect in the machine tool industry.

The trade-in "mechanics" are to be handled by Machinery Trading Corp, a newly-created Fairbanks Whitney division. Frank Reilly, former vice president of United Machinery & Tool Corp, is manager. Headquarters are at 545 Oakwood Avenue, West Hartford.

The program works like this: If a prospective buyer of a Pratt & Whitney machine has an old machine that he thinks has value as a trade-in, a representative of Machinery Trading Corp will make an appraisal which constitutes a credit against a new P&W machine.

If the transaction goes through, Machinery Trading Corp may sell the old machine "as is" to a used-machinery dealer or may rebuild it and then sell it.

What other builders will do . . .

Though no other machine tool builder has put forward as bold and broad a trade-in program as Pratt & Whitney's, at least one builder of general-purpose machines admits that it will accept a trade-in of competitive make if the customer insists and if the machine can be sold to a used-machinery dealer in the customer's territory.

The same builder will take in trade its own old machines and rebuild them in its own plant, reselling them with a one-year guarantee for quality as of the date of original manufacture. Only exception to the rebuilding practice is a machine that is completely outmoded.

Another well-known builder admits that when a customer is reluctant to deal directly with a local used-machinery dealer, it will accept used machines of any make for trade-in credit against one of its new machines. The trade-in then is immediately sold to a dealer in the customer's area.

Still another builder will accept its own used machines in trade provided that they are suitable for rebuilding. It specifies, however, that only a certain percentage of trade-ins to the total new machine tool order is permitted.

Brown & Sharpe recently created much interest by announcing a new plan whereby it would pay $500 for every old B&S single-spindle automatic traded in for a new automatic.

GM may buy for Canada . . .

General Motors of Canada is asking for bids on a production line for automatic transmissions at its Windsor (Ontario) plant.

Such a program is said to have been on and off half a dozen times the past few years. But this is the first time that it has reached the stage of seeking prices from machine tool builders.

Should the project go through, it presumably would be for 1963 models to be introduced in the fall of 1962. It is too late to have the machines built, installed and in production by next fall.

The bulk of any orders for this tooling program would be placed with U S builders, with Canadian builders likely to receive a small chunk.

Whenever General Motors decides to make automatic transmissions in Canada, Ford and Chrysler will be compelled to follow suit.

Chevrolet orders for Cleveland . . .

Chevrolet has placed large orders with two special machinery builders as part of its program for tooling at Cleveland for a new transmission. All of this program, which runs well into the millions, has not yet been allotted to builders.

License to ship to Russia reviewed

As *AM/MM* went to press, we learned that Senator Thomas J Dodd (D, Conn) has asked the Commerce Department to suspend temporarily the license under which Bryant Chucking Grinder Co was to have shipped 45 ball-bearing grinders to Russia. Commerce has agreed to the suspension, pending issuance of a final report on an investigation of the situation by the Senate Internal Security Subcommittee.

Senator Dodd said the subcommittee continued its investigations so as to obtain the opinion of eight or nine experts in the ball-bearing field because of conflicting testimony it had received from the Defense and Commerce Departments.

Defense testified that the grinders were unique and would give Russia a qualitative ability in the small bearing field which it could not otherwise get. Commerce testified that the machines were not unique and that Russia could obtain similar machines elsewhere.

PORTABLE "SERVICE CENTER"
sparks new ideas and savings

Hundreds of companies have saved money, improved products and cut production waste as the result of opportunities presented by the Ryerson "Metalogikit."

How? This unique kit is a veritable portable service center . . . lets you explore many alternatives to material you now use. For example, you can compare several different cutting methods on the same piece of steel to see which is best for your application.

Following are a few random examples showing how Ryerson specialists, using the "Metalogikit," have helped customers with a variety of problems—many similar to those you may face every day.

If you would like to put the Ryerson "Metalogikit" to work for you, call your Ryerson representative for a demonstration—for unbiased recommendations on steel, aluminum, plastics and metalworking machinery.

KIT SPOTS SAVINGS

Scratches and grooves normal to cold drawn, seamless tubing caused high manufacturing costs for a company making small, light-wall hydraulic cylinders. The small I.D. had to be honed to eliminate these faults—often too much metal was removed for proper piston fit. A Ryerson specialist suggested a switch to *welded tubing*. Using a sample from his "Metalogikit," he pointed out the better finish that eliminates expensive honing. The switch was made with these results: higher production, low reject rate, improved product, lower purchase price per foot of tubing.

KIT SUGGESTS PROFITABLE SPEC CHANGE

Fractures and rejects were extremely high for a manufacturer cold forming two severe bends in flat, hot rolled bars. A Ryerson specialist examined the ¾" x 2" bar stock and compared it with a sample of M-1020 flattened round bar from his "Metalogikit." He explained how controlled carbon of Ryerson M-1020 bar would produce great cost-saving advantages in this operation over hot rolled, mild steel. After specs were changed to this Ryerson-supplied bar, fractures and rejects were substantially reduced—bringing new profitability.

NEW ANGLES FOR CUTTING COSTS

In making chairs, a furniture manufacturer was using *rolled* aluminum angles in 6061-T6 alloy where strength was not an important factor. A Ryerson aluminum specialist recommended using *extruded* angles in 6063-T5. Using a sample from his "Metalogikit," he pointed out that this angle would provide all the strength needed in the application, is more easily formed and has a better finish. The change in material was made—cutting costs 15¢ per unit produced.

STAINLESS FROM KIT LEADS TO SAVINGS

This company had an emergency requirement for stainless sheets. Application had always called for Type 304, 16 ga. x 66" x 81", *polished on one side*. Their Ryerson specialist questioned the need for polishing. From his "Metalogikit," he showed them a sample of 304 with a 2B finish. The company readily agreed it was exactly the finish needed *without polishing*—saving delivery time and material cost. The Ryerson man further suggested 16 ga. x 72" x 144", using the cutoff pieces for another job—reducing scrap waste on both requirements. Order was placed and delivered in plenty of time. Over-all result: a substantial saving.

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MATERIALS...

Ultramagnetism...

Indications are that a new columbium-tin compound, as a cryogenic superconductor, will sustain magnetic fields of 100,000 gauss. The material carries currents of 100,000 amps per sq cm of cross-section. Cb_3Sn becomes superconducting at 18K (—255C), a higher transition temperature than any other superconductor known. However, only the magnetic coil, or solenoid, need be at this low temperature. The magnetic field extends outside its source to offer many practical applications. Large volumes of magnetic fields are required for communication equipment, for containing plasma, and for the newest metalworking technique—magnetic forming.

Comparing a superconducting electromagnet to a more conventional magnet using a copper conductor shows the significance of this discovery. A conventional magnet at Bell Telephone Laboratories, where the properties of Cb_3Sn were discovered, requires a power supply and cooling equipment which literally fills several rooms. While in operation, it uses thousands of gallons of cooling water and consumes 1.5 million watts of electric power. To produce a comparable field, the superconducting solenoid magnet requires a unit no larger than a desk and *consumes no energy once the flux is established.* Power needed to sustain refrigeration is negligible compared to the power used by a conventional solenoid.

Considered a rare element until about 10 years ago, columbium now is known to be about as abundant as nickel. It is being extensively studied as an alloying element in structural materials for high-temperature applications. In fact, some of the interest in molybdenum has been shifted to columbium. Also, it is the alloying ingredient in a new series of high-strength, low-alloy steels.

Although many uses for Cb_3Sn seemed evident, its brittle nature delayed practical application. There was no obvious way to make a wire form of the material which would serve as a superconductor in a solenoid. Bell Laboratories' scientists circumvented the mechanical brittleness. They started with a columbium tube ¼-in. OD by 1/10 in. ID and packed it with a mixture of powdered columbium and powdered tin in a 3:1 ratio.

As columbium and tin are ductile elements before they are reacted, the tube could be sealed with Cb plugs and mechanically reduced by swaging and drawing. A 0.015-in.-dia wire, very ductile, was produced and readily wound into a solenoid coil. Once the coil was wound, it was heated to 1000C (1832 F) and the powders reacted to form Cb_3Sn. Superconducting properties developed in this way turned out to be even better than in Cb_3Sn produced by melting and casting.

Electromagnetic force may provide the most significant breakthrough in the application of energy in the next decade. Our seemingly extensive knowledge of motors and magnets and radio waves now seems little more than a stone-age beginning.

Aerospace materials forecast . . .

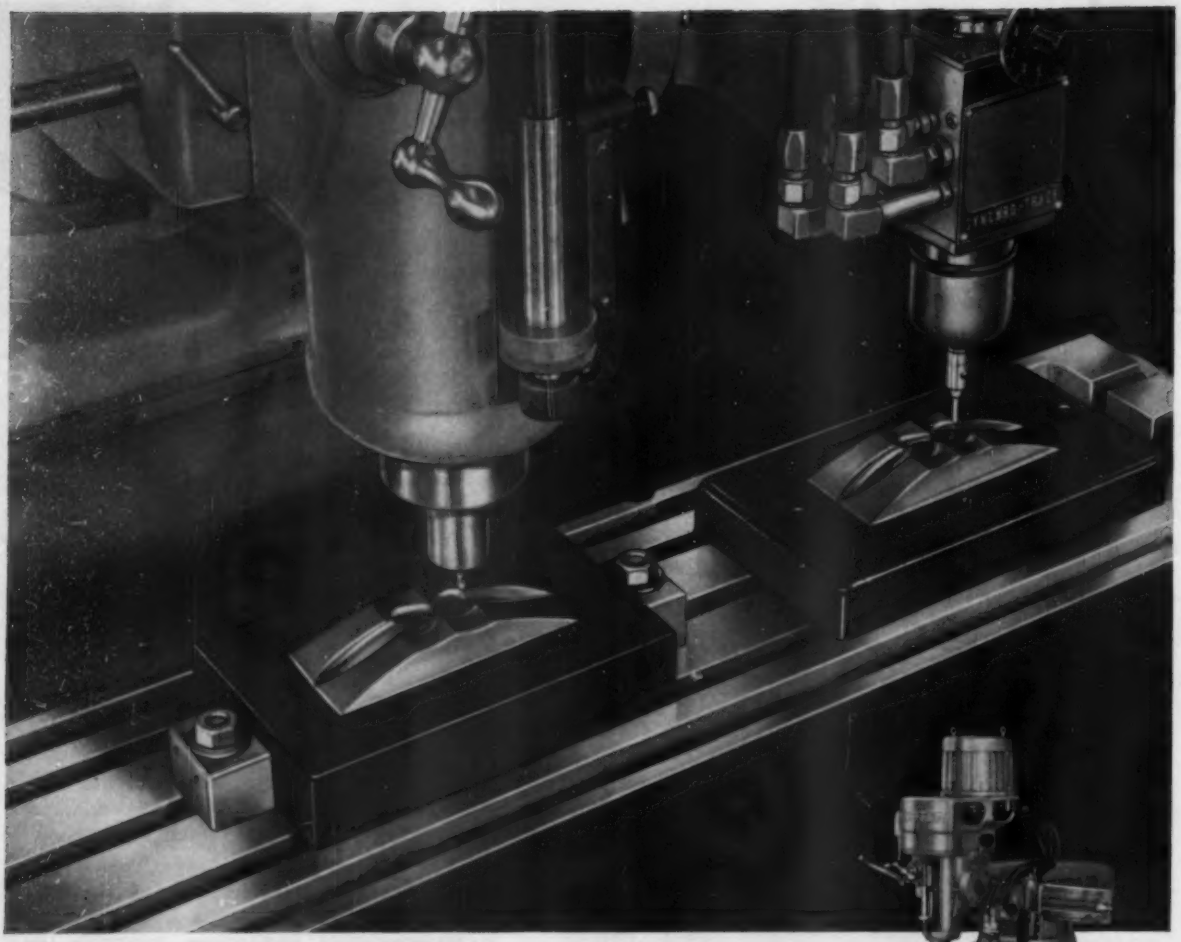
Future plastic sheet materials will achieve high mechanical properties as built-up structures. Sections will be built by laminating ultra-thin gages, of 0.010 in. or less. Equivalent efficiency in integral structures employing other forms would call for practically complete machining. This trend is one of the many foreseen in the Aerospace Industries Association's "Forecast of Technical Requirements."

Use of cast alloys, says the study, generally will reduce in favor of weldments. In high-strength, high-temperature applications, relatively small forgings will be assembled into larger, complex, built-up components. The cost and time to produce very large forgings will not be acceptable.

Among refractory-metal alloys, the tantalum and tungsten systems provide the greatest opportunity for advancement. Presently, alloys of these metals are useful only to temperatures of less than half the melting point of the base metals, while columbium and molybdenum alloys are approaching useful homologous temperatures of 0.65. Refractory metals such as ruthenium, iridium, osmium, and rhenium should experience similar advancements, particularly as alloying elements for the four major metals.

Adhesive-bonded structures will be limited by the adhesives. Present adhesives are limited to 500F for long-time exposure and to 1500F for short-time exposure (minutes). Future predicted temperature limits of organic adhesives is 900F for long-time and 1800F for short-time exposure. For higher temperatures (2000F and above), ceramic adhesives should be developed.

"Heterogeneous alloys" describes materials in which fibers or particles of one material are dispersed throughout a matrix of another material to add strength at high temperatures. Titanium alloys with dispersed particles of Ti_2Cu show over 100,000 psi ultimate tensile at 1200F.



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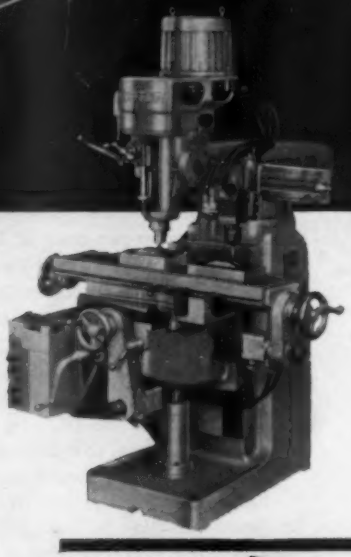

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WHAT'S AHEAD... in Metalworking

TRENDS

Slight rise in production is forecast . . .

Metalworking production, as measured by the AM/MM Production Index, is expected to reach 98 (1957 = 100) in February when all the final figures are in. This is a two point rise over last month.

Another good sign is the increase in steel output. Gains are still quite modest, but the trend is expected to continue. However, with orders from the auto producers, the mills' biggest customers, still lagging, there is little hope for a major upswing before April. But a flurry of spring weather, with a pickup in construction activity and auto buying, could change things.

Welding shop activity is mixed. Most operators report that business is bad—even worse than it usually is at this time of year. These shops expect an upturn in March, with good business from then until October, when many expect another dip. Other welding shops point out that there has been a definite pickup in recent weeks. Loosening up of some missile work and increased activity in the coated specialty field are primarily responsible. Welding fabrication remains slow however.

The news from Detroit is still not good, but auto men attending the recent Chicago Automobile Show were heartened by the huge turnout. Observers interpret this as meaning people are definitely interested in new cars—and the first step in buying is looking.

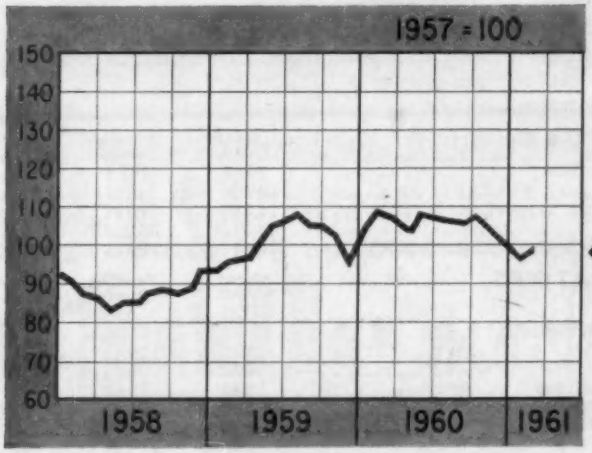
Sheetmetal shops report slow business. Majority, however, foresee a pickup early in April. "Prosperity is just around the corner," says one sales manager. "It's just getting to be a long haul." Improvement is predicted as early as the next quarter and as late as the last.

Manufacturers of materials handling equipment point out the February business showed a gain over January, but that business continues to be a little slow. Outlook for the year as a whole calls for an increase over 1960, or at least an equal volume of business. But spokesmen admit that this outlook is based on a general pickup in the economy.

With the exception of the nonferrous foundries, the foundry picture is none too bright. The producers of nonferrous castings report a marked improvement in their operating rate in the past 30-60 days. The pickup seems to be across the board and is expected to continue throughout the year. Gray-iron founders continue to operate at about 58% of their capacity. The Gray Iron Founders Society reports that its members are optimistic that March should bring an end to the downward trend in their operations.

Steel founders are operating at about 65% of their best peacetime year's rate, and they feel that the recent upturn could not be considered substantial. The outlook here is for a sustained pickup beginning in mid-year. Malleable foundry operators continue to feel the adverse effect of the current automotive situation. Operating rate hovers between 50 and 60%.

Railroad car manufacturers seem to agree that their industry will be the last to benefit from any new boost in the economy.

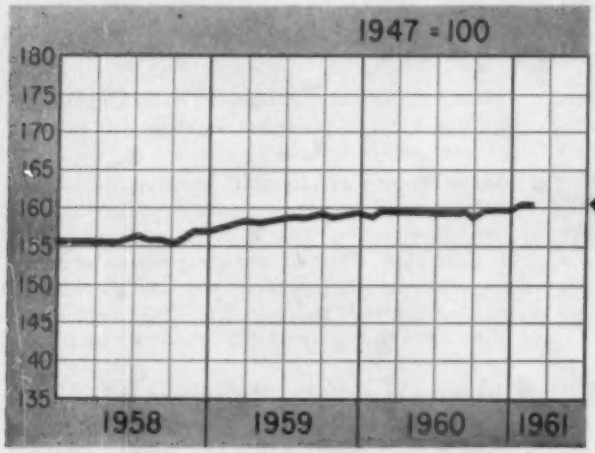


AMERICAN MACHINIST INDEX OF METALWORKING PRODUCTION

BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

	FEB Estimated	JAN Preliminary	DEC Revised	JAN Year Ago
Total Index	**98**	**96**	**99**	**109**
Machinery		**94**	**95**	**106**
Electrical Machinery		**108**	**109**	**117**
Autos		**89**	**98**	**127**
Other Transportation		**88**	**90**	**88**
Other Metalworking		**101**	**105**	**111**

TRENDS WHAT'S AHEAD... in Business



160.4

AMERICAN MACHINIST INDEX OF METALWORKING PRICES

	FEB Estimated	JAN Preliminary	DEC Revised	JAN Year Ago
Total Index	**160.4**	**160.3**	**159.9**	**159.6**
Metalworking Machinery	**195.2**	**195.0**		**189.8**
Other Machinery exc. Electrical	**174.7**	**173.4**		**172.4**
Electrical Machinery	**158.6**	**158.8**		**162.4**
Fabricated Metal Products	**148.0**	**148.0**		**148.0**

Inventories and the course of business . . .

Records of the U S economy's performance in the last quarter of 1960 highlight importance of inventory changes in recent business setbacks. Government estimates show that the gross national product (overall output of goods and services) for the final quarter of the year was unchanged from the preceding three-month period. Actual spending for goods and services, however, continued to edge upward.

Inventory changes accounted for the gap between purchases and output. And these changes have been substantial in recent months.

In 1960's first quarter, inventories grew at an annual rate exceeding $11 billion, thus adding to overall business activity. But in contrast, in the final quarter of the year stocks were reduced at a $3 billion annual rate. This swing from inventory building to liquidation amounted to a $14 billion cut in the gross national product (though increases elsewhere offset some of it). **Currently, inventory reductions are continuing.** And they are responsible for some of the cutbacks in factory output and employment in recent months.

Largely, inventory trimming is concentrated in durable goods producing industries. In this sector of the economy, stocks were hastily built in 1959 to avoid shortages the steel strike might have brought. Still further additions were made in anticipation of a sales spurt early in 1960.

More recently, though, durables sales and orders had been declining. And this decline in business induced durable goods manufacturers to pare stocks.

The key to another upturn in inventory levels lies in an upturn in durable goods business. And recent government actions—including efforts to boost roadbuilding and home construction activities—may be the beginnings of such an upswing. Meanwhile, producers are likely to ease up on their inventory cutting programs in the near future, as stocks are brought into line with current sales and orders. And output then will begin to rise.

WEEKLY BUSINESS INDICATORS

	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1947-1949=100)*	140.6	141.7	159.3
Steel ingot operation (thousands of tons)	1582	1524	2674
Electric power output (million Kilowatt hours)	14,315	14,744	14,226
Production of automobiles	75,531	88,006	158,898
Engineering construction awards (Eng. News-Record—thousands)	56,651	51,319	60,971

MONTHLY BUSINESS INDICATORS

	Latest Month	Preceding Month	Year Ago
Index of industrial production (1957=100)*	102	103	111
Index of durable manufactures production (1957=100)*	95	96	111
Durable goods manufacturers' sales, billions*	13.56	13.81	15.01
Machinery manufacturers' sales, billions*	4.52	4.61	4.72
Durable goods manufacturers' new orders, billions	13.35	13.60	14.77
Machinery manufacturers' new orders, billions	4.57	4.59	4.87
New Orders for Nonelectrical Machinery (1950=100)*	175	159	172
New Contracts for Industrial Construction (1950=100)*	163	190	129

* Seasonally adjusted

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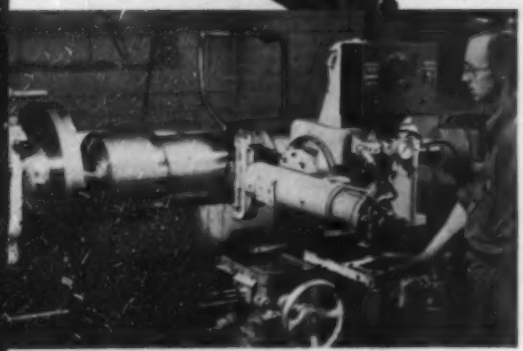

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An Open Letter to President Kennedy

DEAR MR PRESIDENT:

I applaud your advocacy, at a recent National Industrial Conference Board meeting, of "the spirit of a full-fledged alliance" between government and industry. I believe that most everybody in Metalworking will join in the applause.

All of us will subscribe . . .

to your thought that this alliance must devote itself the next few years to three areas of common concern: economic growth, plant modernization and price stability.

Since this is an open letter, before I get to my main point I should like to review some of your thoughts expressed to Conference Board members.

You made the striking statement that "obsolescence is slowing down our growth, handicapping our productivity and worsening our competitive position abroad." Tied in with that was your comment that "nothing can reverse our balance of payments deficit if American machinery and equipment cannot produce the newest products of the highest quality in the most efficient manner."

We as a nation are letting our production equipment get older, you said. Whereupon you backed up your assertion with statistics from the AMERICAN MACHINIST/METALWORKING MANUFACTURING Inventories of Metalworking Equipment.

The 1949 Inventory showed . . .

that less than half the machine tools used to build general industrial equipment were 10 years old or older. Nine years later the 1958 Inventory uncovered the fact that two-thirds were in that age group. You also stressed that in 1958 19% of these machine tools were at least 20 years old.

While our production equipment was getting older, similar machines in other nations were getting younger. You spotlighted Germany as the most spectacular example.

"We must start now," you concluded, "to provide additional stimulus to the modernization of America's industrial plant." Then you told your audience that you intend to propose a new tax incentive for businesses to expand their normal investment in plant and equipment.

You obviously must have been referring to more liberal depreciation on new equipment purchases or to tax credits, for investing in machines, that would lower a company's over-all tax bill.

Now I come to the point of this letter. As you spell out this program and ask Congress to enact it into law, the opposition is bound to be loud and aggressive. Union leaders will charge that any tax incentive plan is a giveaway to industry. They will claim that no such stimulus is needed at a time when the nation has too much rather than too little capacity.

Others in and out of Congress . . .

will say that the national budget cannot stand temporarily to lose important revenue even if the Treasury should be the long-term gainer.

I hope that in the midst of this storm of criticism you will not falter. I hope that you, Secretary Dillon and a Congressional majority will not be swayed from taking the bold action that will start industry once again toward the kind of healthy growth that all of us want.

There is a saying that as capital goods go, so goes the economy. Our allies have found out how true this is. They have offered tax incentives to their industries that have paid off handsomely in economic growth and modernization.

I believe that enactment into law of your tax incentive program will do for us what similar action has already done for our allies. It will start us on our way toward the economic growth, plant modernization and price stability of which you are so able and persuasive an advocate.

Sincerely,

Burnham Finney EDITOR

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VOL 105, NO 5 **American Machinist** / *Metalworking Manufacturing* MAR 6, 1961

SIMPLE TESTS SPOT TELLTALE FLAWS

How good is your incentive plan?

Is your incentive plan really doing the job it should do? Here are some easy-to-construct tables that will help spot dangerous trends

By John R Walley, vice president, Adams-Steele Inc, Chicago

Just how effective is *your* wage-incentive plan? What are its strong and weak points? If you don't have concrete answers to these questions, a few easy-to-construct tables may be just what you need.

Wage incentives are useless unless they provide *real* incentive to a worker, or unless they are administered carefully. What the tables do is point out symptoms that escape routine observation. Once these symptoms are recognized, you can take steps to correct weaknesses before the plan collapses.

These incentive plans, like empires, do not deteriorate overnight—they take time. When they do fail, the cause is usually an accumulation of little, easily overlooked things: A foreman may make a job change without reporting it. Or Time Study may delay, for too long, its re-study of the job change.

In our day-to-day concern with pressing details, we are apt to ignore trends that point out weaknesses in an incentive plan. Then when a trend reaches dangerous proportions—high cost, low productivity—we wonder how it came about. This is the time for action. But frequently management does only the most expedient thing—order a patched-up job that doesn't work to the company's advantage.

Typically, management of one machine shop found that productivity in recent months had been dropping steadily, even though the company had installed an incentive plan some years back. Their current figures showed that average plant efficiency was only 104% of standard (measured by hours of work produced by incentive workers on standard).

Such low productivity is always a sign that something is wrong with an incentive plan. If the shop had maintained the proper records, management could have spotted the downward trend much sooner.

Naturally, symptoms of weakness in an incentive plan vary with the type of plant. But if your plan is tied in with standard hours of measured work, you can always put together records that will simplify analysis of the plan. In fact, one of the chief reasons why flaws appear (and spread) in a plan is that the company doesn't keep tabs on the plan with these records.

Guide to weaknesses in an incentive plan

SYMPTOM: High incentive earnings — low productivity — restricted output. WEAKNESS: Standards too loose.

SYMPTOM: Lack of understanding — very little interest in earning incentive pay. WEAKNESS: Incentive plan too complicated.

SYMPTOM: Workers take incentive earnings for granted, cannot relate their work to bonus pay. WEAKNESS: Wrong basis for plan.

SYMPTOM: Low percentage of incentive coverage — less than 60% of direct-labor hours worked on standard. WEAKNESS: Not enough use made of standard elemental data.

SYMPTOM: An extremely large number of grievances, plus inability to obtain settlement. WEAKNESS: Grievance-handling procedure not properly set up.

SYMPTOM: Workers lack interest — output per manhour is low — very few workers earn incentive pay. WEAKNESS: Workers do not understand how to figure output and pay.

SYMPTOM: Constant complaints and comparison of standards between jobs. WEAKNESS: Too many loose and light standards — time-study ratings are not consistent.

SYMPTOM: Employees work only part of day — rest periods are frequent — workers hold back on piecework tickets. WEAKNESS: Measurement of work is not correct.

Are standards effective?

Let's examine some of the ways that operating figures—easily available in any plant where work is measured—can be put to work to pinpoint weaknesses in an incentive plan.

The first step is to take a long-range view of how effectively standards are being applied. Here the minimum period to analyze is one year (preferably the immediate twelve months past). A longer period is even more desirable, if records are available. These figures should be compiled by months.

In this first step, the answers to two questions are important:

1. What percentage of direct-labor hours is covered by standards?

2. How efficiently are workers on measured operations actually performing?

Fig. 1 is a simple table that answers these questions. This "Effectiveness of Standards Application" form shows incentive coverage as well as performance of workers on operations where work is measured. Notice that, in the example, 65% of total shop hours are worked on time standards, and that plant workers performed at 103% efficiency on these measured hours.

Coverage too low

Competent industrial engineers will agree that when employees working on incentive have only 65% of their hours measured, the coverage is too low. Workers do not, in other words, have enough opportunity to work on incentive; as a result, they can't be expected to take much interest in the incentive plan.

If coverage cannot be kept *well above* 60%, the method of measurement is not suitable for the operations involved. In fact, coverage should be as high as 95% in most plants that make metal products in small lots and a variety of sizes.

The fact is well known that workers must be able, by applying reasonable skill and effort, to earn at least 120% of standard. If they can't, they will not attempt to produce enough to earn incentive pay. Then, of course, the motivating force of an incentive plan simply disappears.

Fig. 1 shows that plant workers as a whole were performing at 103% of standard. When plantwide performance is this low, any one or more of five things can be wrong: (1) Workers are not putting forth enough effort; (2) they are not interested; (3) standards are set incorrectly; (4) training is needed, so that workers can meet standards; or (5) workers do not understand how much they must produce to earn incentive pay.

As a guide to spotting weak points in incentive plans, the form has this significance: It points out inadequate opportunity for incentive, and it reveals whether the premium paid to workers is insufficient. It can show, as the example in Fig. 1 does, that employees do not get to work enough hours on incentive, and that when they do their earnings usually are too low.

Daily incentive reports

Fig. 1 gives an overall view of the incentive program. For a more detailed analysis, a second simple form —the "Daily Incentive Report"— should be prepared. This report narrows the view to a specific department, and the operation and performance of individuals. Fig. 2 is a typical example.

In the example, the line of semi-automatic screw machines had been on incentive for some months. But when management instituted the Daily Incentive Report, a number of faults immediately became apparent. Incentive coverage was too low; only one worker earned incentive pay on the day shown; and departmental efficiency was less than 100%.

Attacking these problems, management talked to the workers and found that they had no concept of the number of parts they had to produce in an hour to earn incentive pay. This is not an unusual situation, but the results are always the same— low productivity.

The solution here was to post a chart on each machine, so that operators could calculate hourly output for each job. These charts were simple ones, which converted standard hours per piece to units per hour. Once each operator had these instructions (together with examples that showed how to calculate re-

EFFECTIVENESS OF STANDARDS APPLICATION

	A	B	C	D	E
MONTH	TOTAL SHOP HOURS	HOURS WORKED ON STD.	% OF COVERAGE B÷A	EARNED HOURS	EFFICIENCY % OF STANDARD D÷B
January	25211	16208	64	17033	105
February	24408	14687	60	15392	104
March	27210	17914	66	18604	104
April	26909	17190	63	18122	105
May	25400	15781	62	16209	103
June	26871	17129	64	17379	101
July	15210	8670	57	8640	100
August	25388	17204	68	17936	104
September	26109	16402	63	16832	103
October	28791	20128	70	21108	105
November	23210	15551	67	15910	102
December	25112	17398	69	17563	101
Total	299829	194262	65	200728	103

Fig. 1—This simple table reveals how effectively standards are being applied in the overall plant. Here the hours worked on standard (65%) and the efficiency of workers on these standard hours (103%) are too low

DAILY INCENTIVE REPORT

Department Auto-Screw Machines Date 10/21/60

Name	HOURS Worked	Day Work	Delay	On Std.	Earned	Eff % Std.
Marcella Jones	8.0	4.0	1.2	2.8	3.3	118
Pauline Griffin	8.0	5.9	.5	1.6	1.4	88
Anita Williams	8.0	8.0	—	—	—	—
Kathleen Reilly	8.0	6.7	—	1.3	.9	69
Dorothy Rollan	8.0	3.9	1.6	2.5	1.9	76
Jeanette Hummel	8.0	8.0	—	—	—	—
Carolyn Seitz	8.0	7.0	.2	.8	.6	75
Totals	56.0	43.5	3.5	9.0	8.1	90

Fig. 2—Daily incentive report will show three possible areas of weakness. Here (1) not enough hours are worked on incentives (only 9 of 56); (2) departmental efficiency percent of standard (90%) is too low; and (3) not enough workers earn incentive pay when on standards

quired output per hour), the fundamental problem was solved. Operators took renewed interest in their work, prompting a demand for greater incentive coverage. Soon the efficiency percent of standard was within a satisfactory range of 120 to 130%.

Analysis of earnings

A third record that will highlight weaknesses in a wage-incentive plan comes from the company payroll. A calculation should be made of the average incentive earnings for each base hourly rate in the shop. If the base rates are correctly evaluated, incentive earnings should fall within the range of 20 to 30% of base hourly rate.

Fig. 3 shows this analysis of incentive earnings. In this example, incentive earnings on low-rated occupations are higher than those on the higher-paid. This situation is potentially dangerous, for skilled workers resent seeing unskilled personnel take home higher actual pay than they do.

When incentive earnings are high in relation to a fairly evaluated base rate (above 30% in Fig. 3), the company may ultimately have to abandon or replace its incentive plan, because labor costs will become prohibitive. When incentive earnings are consistently lower than 20% of base pay, employees will gradually lose interest in the plan. Then its effectiveness as a management tool is lost.

Actually, the area of satisfactory return to both management and the employee is narrow. But if both parties are to benefit in the long run, management should remember that *payment either above or below the range can only cause trouble, sooner or later.*

If the company operates on the theory of low base rates and high incentive earnings, this "Analysis of Incentive Earnings" form can still be of use. Here, however, the incentive-earnings range (solid lines in Fig. 3) must be set at control limits dictated by company policies. The chart will still point out discrepancies in incentive earnings for the various base hourly rates.

Weak administration

Quite often it is not the incentive plan that is at fault. Rather, the administration of the plan is weak. A key indication of this problem can be found by testing the performance-leveling ability of time-study men who establish work standards.

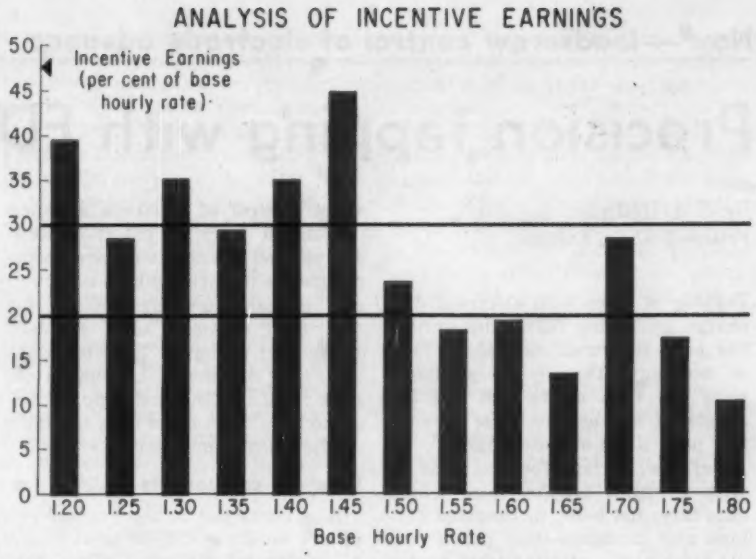


Fig. 3—Incentive earnings for all base rates should fall within an acceptable range (solid lines), not vary above or below the range. Here higher-paid workers are penalized, possibly because standards for their operations are not equitable

There are two ways to conduct this test: (1) Show movies of workers performing a shop operation, and have each observer rate the work pace; or (2) have all the observers rate an employee actually doing work on a job.

The results of thes tests become readily apparent when charts are prepared. One such chart (not shown) might be made showing an observer's ratings on, say, twelve different operations. Horizontal lines might be drawn to represent the percent variation from standard (either on the tight or loose side) for each of the observations. If the variation is noticeably chaotic, one can assume that the observer lacks the fundamental ability to rate. If, on the other hand, he is consistent in his errors—either on high or low side—he can probably be trained to rate within acceptable limits. The inconsistent rater doesn't belong in time study.

When time-study men do not rate consistently, it almost always follows that standards are set too high in some departments and too low in others. Then the union has an ideal excuse for pointing to high rates and pressuring management into boosting low ones. Ultimately, this situation leads to high costs with which management cannot live.

When metalworking plants use standard elemental data, developed from grouping and averaging many time studies, they eliminate the "peak and valley" type of standard setting. Such data *can* be developed for all operations in a plant: machining, fabricating, heat treating, testing, and assembly.

Symptoms of weakness

The simple forms and tests described above should bring to light major weaknesses in a wage-incentive plan. Still another way to isolate faults is to use a guide similar to that shown on p 69. Here is a list of several symptoms that indicate something is wrong with the incentive plan.

Once the weakness is known, management can start a corrective program. Just as "half the problem is solved by the time you can identify it," so it is with weaknesses in an incentive plan.

Any system deserves constant supervision. Management should audit its incentive plan periodically—at least once a year. Or, far better, management should install controls (similar to those described here) that will tell it the incentive story as it unravels each work day.

When a company makes periodic or continuous audits of its plan, it obtains three major benefits:

- Weaknesses can be discovered in time to take corrective action.
- The company will not be caught by rising labor costs that will gradually jeopardize its competitive position.
- Workers will earn high wages, because with correct standards productivity will stay at a high level. •

Now—leadscrew control of electrode advance

Precision tapping with EDM

By S A Hoffman, engineer,
Portage Tool Co, Chicago

Tapping of holes with electrical discharge machining (EDM) up to now has been somewhat limited by lack of accuracy. Threads so produced have not been up to tool and die standards, because electrode advance has been a hit-or-miss affair.

But now, Portage Tool has come up with an EDM tapping head which cuts threaded holes in tungsten carbide and hardened-steel punch and die parts to an unprecedented degree of accuracy. Portage's secret: leadscrew control of electrode advance.

Matched pairs of precision leadscrews and mating nuts are incorporated in the head, which is mounted vertically on the end of the horizontal crossarm of a standard Bridgeport miller. A T-slotted work table and coolant tank from an old Elox EDM drilling and tapping machine have been fitted onto the table of the milling machine.

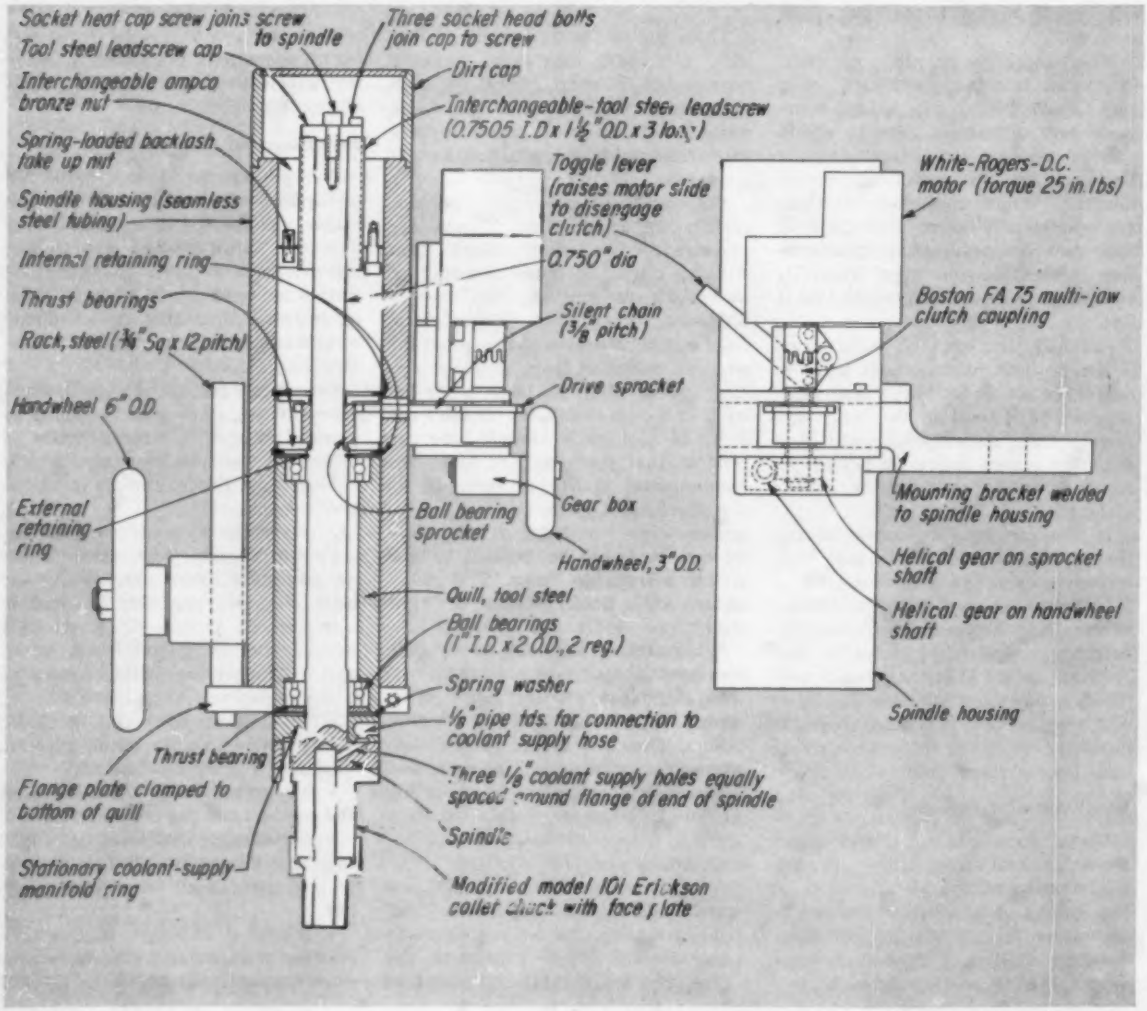
Uses old components

Also employed in the Portage setup are an Elox NPS-15 power pack from the old machine, along with head and table control cabinets. The old table assembly is insulated from the table of the mill.

Leadscrews for the new head are 1.500 in. OD and 3-in. long cylinders of Graph-Mo steel—hardened and drawn to Rh 60-62 C, and finished by grinding bores and threads.

These leadscrews have 0.7505-in.-diameter concentric bores for a close slip fit over the 0.7500-in.-diameter upper end of the tapping spindle (see sketch). Upper end of each leadscrew has a Rh 60-62C hardened tool steel cap, so it can be connected tightly to the end of the tapping spindle with a 5/16-18 socket head cap screw.

Mating 2.5000-in.-OD, 3-in. long


Socket head cap screw joins screw to spindle
Three socket head bolts join cap to screw
Tool steel leadscrew cap
Dirt cap
Interchangeable ampco bronze nut
Interchangeable-tool steel leadscrew (0.7505 I.D x 1½" O.D. x 3 long)
Spring-loaded backlash take up nut
Toggle lever (raises motor slide to disengage clutch)
White-Rogers-D.C. motor (torque 25 in. lbs)
Spindle housing (seamless steel tubing)
0.750" dia
Internal retaining ring
Boston FA 75 multi-jaw clutch coupling
Thrust bearings
Silent chain (⅜" pitch)
Rack, steel (¼" Sq x 12 pitch)
Drive sprocket
Handwheel 6" O.D.
Mounting bracket welded to spindle housing
External retaining ring
Gear box
Ball bearing sprocket
Handwheel, 3" O.D.
Helical gear on sprocket shaft
Quill, tool steel
Helical gear on handwheel shaft
Ball bearings (1" I.D. x 2 O.D., 2 req.)
Spring washer
Spindle housing
⅛" pipe tds. for connection to coolant supply hose
Thrust bearing
Three ⅛" coolant supply holes equally spaced around flange of end of spindle
Flange plate clamped to bottom of quill
Spindle
Stationary coolant-supply manifold ring
Modified model 101 Erickson collet chuck with face plate

precision Ampco 18 bronze nuts are finished to a close slip fit in the 2.5005-in.-diameter bore of the 3¾-in. OD, 12⅛-in. long seamless steel tube which forms the housing of the tapping head.

A 0.500-in. wide undercut keyway is then milled longitudinally along the outside of each nut, for hardened steel keys held in the bore of the spindle housing with socket head cap screws. This arrangement permits locking the nut-and-leadscrew assembly in the spindle housing at whatever position is found most desirable for a given operation.

Minimizing backlash

Attached to the lower end of each nut with three sockets head step screws is an identically-threaded, ½-in. long, spring-loaded nut for minimizing backlash between the nut and its mating leadscrew.

Nut-and-leadscrew sets have to date been made with pitches of 12, 13, 14, 16, 18, 20, 24, 28, 32 and 40 threads per inch.

Lower end of the 14½ in. long tapping spindle is supported with two Boston 1641 DS (1-in. ID, 2-in. OD) precision ball bearings concentrically in a 2.5000-in. OD, 5⅝ in. long Graph-Mo tool steel quill that is ground and lapped for a smooth sliding fit in the 2.5005-in. bore of the spindle housing.

Between the lower end of the quill and the 2½-in.-diameter flange on the lower end of the spindle is a hardened (Rh 60-62C) Graph-Mo tool steel stationary coolant-supply manifold and a spring washer which holds the manifold ring tightly against the face of the spindle flange.

This flange is drilled at 30° with three equally spaced ⅛-in.-diameter holes which feed coolant from the manifold ring to the modified Erickson collet chuck, in which threaded brass electrodes are clamped for tapping operations. An oil seal in the chuck prevents coolant leaking around the outside of the hollow electrodes.

For vertical adjustment of the quill and spindle assembly, when the keys holding the bronze leadscrew nut in the spindle housing have been released, a 12-pitch, 7-in. long rack is mounted vertically on a flange plate clamped to the lower end of the spindle. This rack mates with a small pinion on the shaft of a 6-in.-diameter handwheel at the left-hand side of the spindle housing.

Experience has shown that this coarse adjustment of the spindle seldom is necessary. The rack usually serves only to prevent rotation of the quill as the spindle-and-quill assembly is fed vertically by rotation of the leadscrew in its mating nut. A longitudinal keyway in the quill and a mating key in the bore of the housing would serve equally well.

Also mounted vertically on the quill flange is a ¾-in.-diameter, 8-in. long crs post with a flatted side. Adjustably positioned on this post is a bracket carrying a micrometer head which serves as an automatic feed stop. This is accomplished (when the electrode has been fed to the depth desired) by setting the micrometer spindle to open a normally-closed precision Micro Switch, which is in an oilproof housing on a bracket fixed to the lower end of the spindle housing.

With this automatic stop arrangement, a tapping cut can be started and the machine left running while the operator performs other work at another machine.

Above the quill, in the approximate center of the spindle housing, is a Boston KSA12 silent chain sprocket, bored out to take a ball bearing bushing (see sketch) which allows passage of the spindle through the sprocket with minimum friction.

A setscrew with a flatted point is entered through the side of the sprocket hub into a 3/16-in.-wide longitudinal keyway in the spindle, so that rotation of the sprocket turns the spindle.

Retaining rings and hardened Graph-Mo tool steel thrust bearings support the sprocket within the bore of the spindle housing, keeping the sprocket through small helical gears), in the wall of the housing. This allows entry of the silent chain, which connects the spindle sprocket with a similar sprocket in the drive mechanism at the right-hand side of the housing.

Spindle rotation through the chain connecting the two sprockets can be accomplished manually with a small handwheel (connected with the drive sprocket through small helical gears), or with a DC drive motor with 25 in.-lb torque. A Boston FA75 multi-jaw coupling serves as the clutch connecting the White-Rodgers drive motor with the drive sprocket.

A manually actuated toggle lever arrangement raises the motor on its supporting slide, thus disconnecting the multi-jaw coupling when manual rotation of the spindle (for positioning an electrode) is desired.

Quality of threads is now so much superior to those threaded with the old EDM machine that the cost of the new unit has been fully justified. •

Battelle cold-extrudes titanium fittings

Production of titanium fittings by conventional machining methods has been so costly that their use has not been justified. Now, Battelle Memorial Institute has developed cold extrusion techniques that cut almost one-half from manufacturing cost.

As part of a study for the Air Force's Manufacturing and Materials Technology Division, Battelle chose a No. 10 hex nut (of the type used for tube fittings) for its pilot run.

Full-size hexagonal cups were backward extruded in one operation from solid cylindrical AMS 4902 unalloyed titanium billets 1 in. diameter by ⅝ in. thick. The operation involved a 55% extrusion reduction and pressure of about 335,000 psi. The hex cups, 1 in. across flats by 1 in. long with 25/32-in. bore, were then finish machined and threaded on a screw machine.

Not only is the starting billet used in cold extrusion only half the weight of the one required for screw machining, it can be cut from round barstock instead of from more expensive hex stock. Material cost for a nut made by cold extrusion plus finish machining amounts to $0.64 compared to $1.52 for one produced entirely on a screw machine. Overall manufacturing cost saving is 48.5%.

The aim of the study was to establish the necessary basic technology for cold extruding actual parts from titanium on a commercial basis. Punch-tip designs from hemispherical to nearly flat were evaluated; the best contour seemed to be a segment of a circle with a 140° included angle and a 1/32-in.-long cylindrical bearing. Extrusion pressure with this punch design was about 15% lower than that with a nearly flat tip.

Extrusion pressure can be further reduced by tapering the billet toward the bottom. But because eccentricity of the cup increases with taper angle, 10° seems the practical limit.

Of the commercial titanium alloys studied, Ti-3Al-2.5V and Ti-13V-11Cr-3Al showed the best extrudability from the standpoint of pressure requirements. Ti-3Al-2.5V was also extruded into hex cups but moderate heating was required. •

President pushes, Congress expected to act

New tax incentives promise capital spending stimulus

"We must start now to provide additional stimulus to the modernization of America's industrial plant." So said President Kennedy in his recent address to the National Industrial Conference Board. Citing figures from AM/MM's 1958 Inventory, he pointed out the increasing age of U S industrial equipment, and said that he would propose to Congress a new tax incentive to stimulate business spending in new plant and equipment.

The kind and size of the recommendation Kennedy will propose was still very much up in the air as *AM/MM* went to press. The maneuvering has been almost entirely behind the scenes—in talks between Treasury officials, Ways & Means members, the President's Council of Economic Advisers, the Commerce Department, and others. Businessmen have been consulted, but mostly in a very hush-hush atmosphere.

Ideas in the mill

• **The investment credit proposal**—the most talked-about proposal, and the one that may well be recommended by the administration—is the one suggested by the tax-policy task force headed by Stanley S Surrey, Assistant Secretary of the Treasury for tax matters.

Here's how it would work. Suppose a company spends $1 million on new equipment, and has depreciation allowances on its books for that year of $800,000. It would subtract from the tax it would otherwise owe the government a percentage of the remaining $200,000. If a 10% rate were applied (range discussed is from 5% to 20%), this would amount to a reduction of the firm's income tax bill by $20,000.

• **A variation of the Surrey proposal**—similar to that used in England and some other foreign countries—would give a firm such a credit without reference to its depreciation account. Thus on the same $200,000 in the example above, a 2% credit allowed on the $1 million of spending would reduce the firm's tax bill by the same $20,000.

Other variations of the tax credit idea would apply a step-down percentage rate as the amount of investment went up. The idea: Help smaller companies by applying a larger percentage credit on, say, the first $100,000 of investment, or some such figure. Precedent for such a principle exists in our present law on depreciation.

• **Five-year writeoff** — Senator George Smathers (D-Fla) has introduced legislation which would revive for all spending on plant and equipment the five-year amortization allowed on defense plant and equipment during World War II and for specified percentages of plant and equipment during the Korean war.

• **Temporary increase in depreciation allowances** — Representative Wright Patman (D-Texas) has proposed that for a two-year period businesses be allowed to deduct 100% of the cost of capital equipment acquired, up to a maximum of $500,000. After 1962, depreciation allowances would drop back to where they are now.

• **Increased initial writeoff** — One proposal that may windup in the tax package Congress passes would be a liberalization of the special initial allowance adopted by Congress in 1958 as an anti-recession benefit for small business. It provides that over and above normal depreciation schedules a firm can take an additional writeoff deduction of 20% on purchases totaling $10,000 (or $20,000 for joint husband/wife returns). The allowance applies to purchases of equipment only; buildings and structures are ineligible.

The present proposal is to lift this $10,000 ceiling. A ceiling of, say, $1 million would give a company spending that much a brand-new writeoff the first year of $200,000, over and above the regular depreciation schedule it chooses to follow.

• **Bulletin F revision** — Representatives Howard H Baker (R-Tenn) and A Sydney Herlong, Jr (D-Fla) are backing a bill they have been pushing for some years. Besides providing a one percentage point reduction in all corporate income-tax rates each year for a 5-year period, it would also provide for five annual reductions of 5% each in the tax-life figures spelled out in Bulletin F of the Internal Revenue Service.

• **Reinvestment depreciation deduction**—A bill introduced by Senator Vance Hartke, (D-Ind) would provide a deduction for depreciation measured by the cost of the reinvestment necessary to maintain the size of a taxpayers investment. This would be conditioned on actual reinvestment by the taxpayer of the amount equal to the replacement cost of old assets sold or dismantled during the year.

• **Additional aggregate investment**—A bill introduced by Senator Sparkman (D-Ala), Representative Frank Ikard (D-Texas) and Representative Thomas B Curtis (R-Mo) would allow a business to deduct from its income an amount equal to the additional aggregate investment in depreciable assets, inventory, or accounts receivable during the tax year. There would be a maximum of 20% of such income, or $30,000, whichever is greater.

Key factors involved

How much incentive the administration finally recommends is tied by politics to the size of the estimated revenue loss to the Treasury—at least during the first years. Proponents of rapid depreciation claim that, in fact, there is no loss to the Treasury over the long haul. But at the outset, when larger allowances are permitted, the taxpayer keeps dollars that would otherwise go to the Treasury. One argument against the investment credit idea is that it represents a kind of deduction not tied at all to recovery of the cost of a capital asset; there is no recovery ever under any circumstances. The theoretical basis for this incentive is its direct stimulation to spending on plant and equipment.

One bit of speculation is that the Treasury will agree to a tax incentive revenue reduction of, say, $1.5 billion.

But whatever the amount, Kennedy will recommend, and Congress will vote, some revenue increases to offset the loss on the tax incentive. Among the proposals: An end to the dividend credit, perhaps a system of withholding on dividends and interest payments, an end to the elimination of the 25% capital gains rate on income from depreciated equipment.

Congress may wind up wrapping several tax ideas into a single package—a Revenue Act of 1961. And it might also include "something for the individual taxpayer."

Machinery orders expected to dip 2% in 1961

1960	Total Machinery: Seasonally adjusted	Total Machinery: Unadjusted	Pumps & compressors	Engines & Turbines	Construction & Mining Mach.	Metalworking Machinery	Office Machinery	Other Ind. Machinery
I Q	169	177	327	161	193	168	220	154
II Q	180	184	321	180	197	175	227	161
III Q	176	168	296	139	159	176	216	149
IV Q	162	158	303	128	138	179	221	136
1961								
I Q*	158	165	286	124	160	169	227	148
II Q*	170	174	293	137	163	174	236	159
III Q*	173	165	300	130	155	168	226	146
IV Q*	176	171	307	143	157	175	254	148

*Forecast made in mid-January, 1961. (1950 = 100)

Manufacturers of capital goods now predict that the dollar volume of their new orders in 1961 will average 2% below last year. The current quarter is expected to be the low point for this year, with new business rolling in at successively higher levels in each of the following quarters. By the last quarter of 1961, the index of new orders is expected to average about 9% above the comparable quarter in 1960.

According to the quarterly McGraw-Hill Machinery New Orders Forecast, manufacturers in four of the six individual machinery categories expect their orders will average somewhat lower this year than last, one group anticipates an increase in orders, and the other forecasts no change in incoming business.

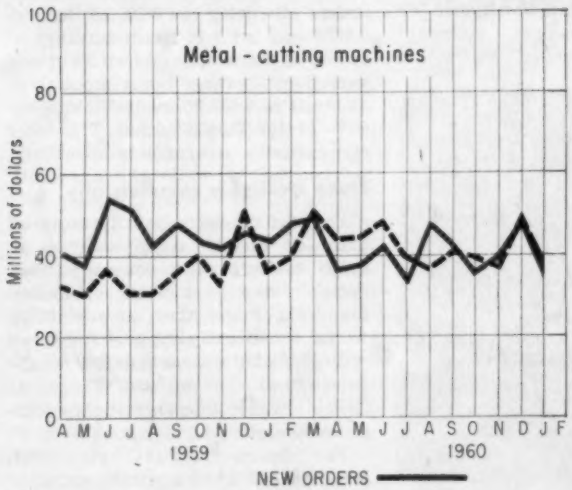
Metalworking machinery off 2%

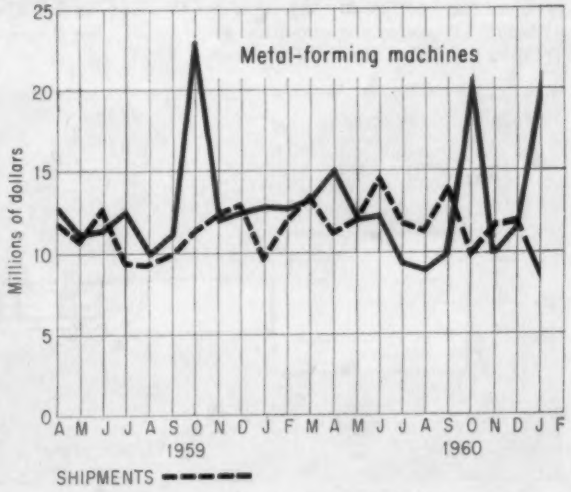
In mid-January 1961, when this forecast was made, builders of metalworking machinery were predicting that new orders will be off about 2% in 1961.

Producers of office machinery predict that 1961 new orders will run 6% higher than last year, and manufacturers of "other industrial machinery" (general-purpose and special-purpose industrial machinery) foresee the same level of new business bookings for this year as last, at an index level of 150 (1950=100).

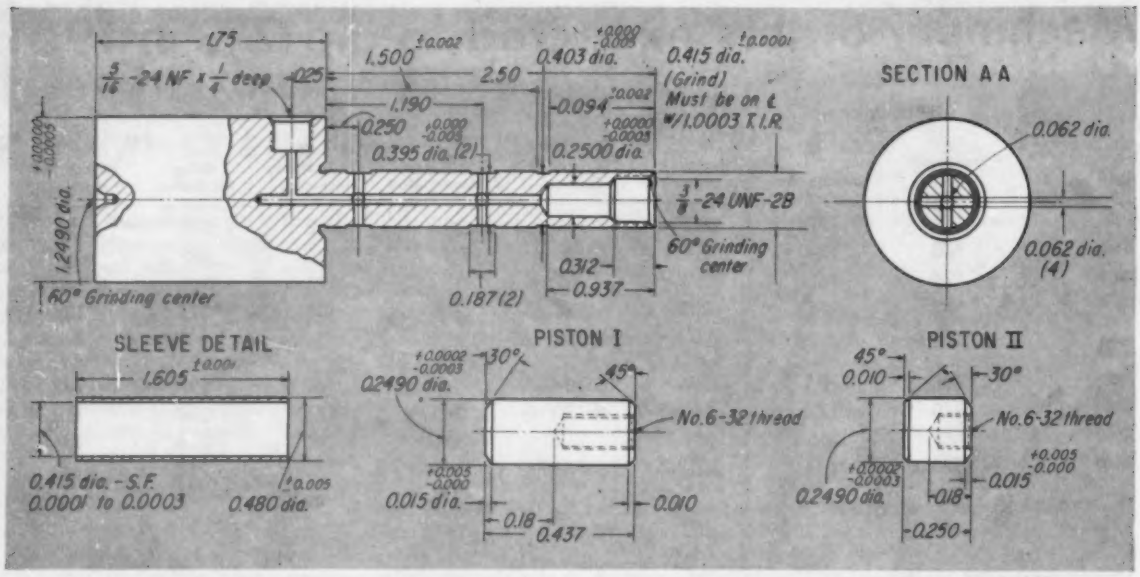
In the engine and turbine category, manufacturers predict a 12% decline in new orders this year. Pump and compressor manufacturers anticipate a decline of about 5% in 1961. Builders of construction and mining machinery are forecasting a decline of 7% in new business. •

NMTBA Index of machine tool new orders and shipments





Net new orders for metal-cutting machine tools dropped in January to $35,800,000, according to preliminary figures from the National Machine Tool Builders' Association. Domestic orders accounted for $20,800,000 of the total; foreign orders, $15,000,000. Shipments reached $38,150,000. Orders for metal-forming machines rose to $20,100,000 in January. Domestic orders were $16,450,000; foreign orders, $3,650,000. Shipments were $8,600,000.



The workpiece: Tubular beryllium-copper cylinder for precision inertia switch must be finished within 0.0005 in. TIR, with diameters held within 0.0003 to 0.0005 in. as indicated. Piece is made from copper rod, is age-hardened at 600 F for 4 hours, and is stabilized at 69 to 71 F for 60 minutes. Hardness averages Rh 40C (Rh 36C minimum)

Grease-filled expanding mandrels

Hydraulics aid precision holding

By Rodney Schultz and Karl Grimm, production engineers
Minneapolis-Honeywell Regulator Co, Minneapolis

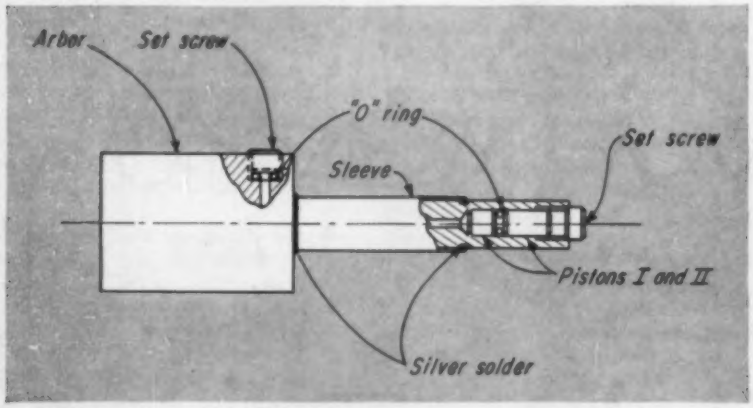
Small tubular cylinders are extremely difficult to hold for finish-turning operations, especially when tight tolerances and concentricity must be maintained. This knotty workholding problem has been neatly solved with hydraulically expanded mandrels developed by Minneapolis-Honeywell.

With them the company has cut floor-to-floor time per piece (tubular cylinders for precision inertia switches) by nearly 2 minutes, and has cut scrap losses 25%.

Both ends of the workpiece (a small beryllium-copper cylinder) must be finish-turned to within 0.0005 in. of specified diameters, and must be concentric with the bore within 0.0005 in. TIR (total indicator reading) when the bore is later finish-honed.

Bores of the age-hardened and stabilized tubes (Rh 40C average hardness) are rough-honed to 0.438,20 inches diameter (+0.000,15 in., — 0.0000 in.) prior to finish turning.

Out-of-roundness and straightness variations in these bores amount to as much as 0.000,25 inches, taking up 50% of the 0.0005 inches TIR total concentricity tolerance allowable.

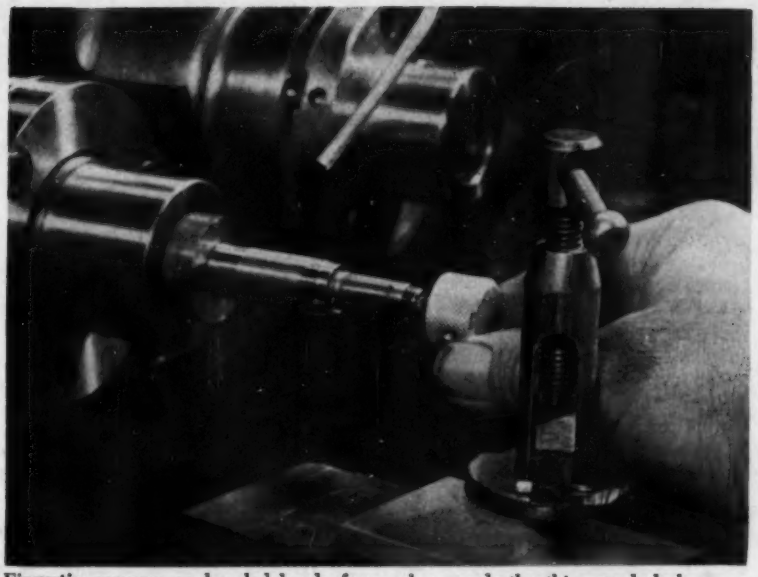


Assembled mandrel is made to precision tolerances and filled with a light grease or heavy oil. Hydraulically expandable, the mandrel exerts even pressure throughout the bore of the workpiece it supports and drives. Only light turning pressure is necessary on the setscrew

None available commercially

For this reason, carefully centered precision mandrels are essential in finish turning. The company tried commercially available expansion mandrels, found that none of them would consistently support the tubes with sufficient accuracy for finish-turning within the 0.000,25 inches TIR allowable tolerance. Scrap losses were high.

Far better results have been achieved with hydraulically expanded mandrels, supported from the spindle of an Ex-Cell-O boring machine tooled with cross slides for supporting single-point turning tools.



Fingertip pressure on knurled head of wrench expands the thin mandrel sleeve so that opposite ends of inertia switch cylinders can be finish-turned in the spindle nose of an Ex-Cell-O precision borer. Mandrel (left) is expanded with contained grease by movement of piston assembly in outer end of mandrel body

Basically, a contained charge of heavy oil or light grease expands the thin wall of the mandrel sleeve (which is also of beryllium copper) against the bore of the work. A light grease, compounded for lubricating lathe center points, works well.

Silver-solder joints

The mandrel's expandable sleeve fits tightly around the 0.4150-in. (±0.0001 in.) diameter tool steel body of the mandrel, is attached to the mandrel at both ends with silver-solder joints melted into undercuts. Soldering must be done carefully to insure against leaks, which would release hydraulic pressure within the mandrel assembly.

Two 0.187-in. wide, 0.010-in.-deep circumferential grease channels are turned and ground in the body of the mandrel. Each of these channels is connected through four equally spaced, 0.062-in. - diameter radial drilled holes with a 0.062-in. longitudinal manifold conduit drilled along the axis of the mandrel.

A filling hole in the large end of the mandrel is connected to the longitudinal conduit with a 0.062-in.-diameter cross hole, and is closed with a socket-head setscrew and a Neoprene "O" ring seal.

In the outer end of the mandrel, the longitudinal grease conduit is enlarged to form a 0.2500-in. (+0.0000 in., –0.0005 in.) diameter compression cylinder into which a piston assembly is forced by a socket-head setscrew.

The piston assembly consists of three separate parts: two 0.2490-in. (+0.0002 in., –0.0003 in.) diameter brass piston slugs and a separating ¼-in. OD, ⅛-in. ID Neoprene "O" ring seal. Inner piston unit is 0.250-in. long, the other is 0.437 in. long. Both are chamfered on both ends and have a tapped hole in one end for easy removal from the mandrel when cleaning or repairs are necessary.

When the assembled mandrel has been centered and locked into the spindle-nose of the turning machine (and filled with grease), the OD of the beryllium-copper expandable sleeve is careful'y turned round and straight, so that it is approximately 0.0008 in. smaller than the minimum diameter of the work.

This leaves a wall thickness of 0.011 to 0.012 in. and requires expansion of the sleeve diameter to contact and hold bores of the work.

Expansion is easily accomplished with finger-tip pressure on the knurled head on a short section of hexagonal steel rod, which forms the wrench with which the mandrel is expanded.

Experience has proven a conventional socket-head setscrew wrench should not be used with the mandrel. Excess pressure on the setscrew, which moves the compressing piston assembly, easily expands the mandrel sleeve sufficiently to crack the workpiece, even though its wall thickness is about 0.093 in.

Quality-control capability studies show a 0.0002-in. maximum spread on TIR concentricity and a 0.000,15-in. maximum variation in diameters of areas at each end of the beryllium-copper cylinders turned on the mandrels shown.

Mandrels of this design easily can be constructed to hold parts with bores as small as ¼-inch, or as large as 2 inches or more. •

Lot sizes decrease in big plants

Average lots are tending to decrease in size in large plants. At the same time, they are tending to increase in size in small plants. These two trends show up in a recent survey conducted by *AM/MM*.

In plants of all sizes 46% report that lots are getting larger, 24% say they are getting smaller. The remaining 30% see no change.

The decreasing lot size in large plant suggests that these companies are exercising closer control of inventories and have increasing flexibility of equipment. It may also result for the greater number of models being offered.

In contrast, the increasing lot sizes in the small plants may be the results of more mechanized equipment. Detailed results by plant size are show in the table below.

Employees	Increase	Decrease	Same
Over 1000	34%	40%	26%
500-999	39	37	24
100-499	51	22	27
50-99	50	19	31
1-49	42	22	36
Average, All Plant Sizes	46%	24%	30%

Good tips for your soldering iron

Some new ideas and helpful hints to improve that most vital (and neglected) art — soldering

By Joseph D Keller, group leader, metallurgical research
The Martin Co, Orlando, Fla

The focal point of any soldering operation is the soldering iron tip, where all the work is done. But how many shops, even those in the electronics industry, where soldering plays a big role, take the time to analyze and update their methods?

Important as it is, soldering has come to be a somewhat neglected stepchild of the metalworking industry. Recognizing this, Martin-Orlando a few months ago launched an intensive investigation into its own soldering methods, and into the progress of the art.

Out of this survey has come a set of recommendations that not only updates practices in our shop, but probably can apply to any other electronics manufacturer.

For our own work, we found that these are the most useful types of soldering tips: narrow semi-chisel, pyramid, and sharp conical.

Whenever there is a choice, the largest practical soldering tip should be used. Tests show conclusively that a ¼-in.-diameter tip will heat a large turret lug with a wrap of No. 18 wire to 550 F in 1¾ seconds; while a ⅛-in. tip will only produce 465 F in 3 seconds—in the same iron.

Larger tip preferred

A larger tip is easier to maintain in good working condition, and its life is usually much longer. The area available for heat transfer is larger, and the "watt density" is lower. Hence, oxidation due to excess heat is less with a larger tip.

Iron-coated tips are best for general-purpose and printed-circuit soldering, but freshly-tinned copper tips work best for miniature "cup type" connections. Both kinds of tips should be wiped, just before soldering, on a cellulose sponge wetted with water.

Tip Life

A tip properly coated with iron can be submerged in a solder pot operating at 500 F for over 6000 hours. But a plain copper tip under the same conditions will last less than 30 hours.

The heat conductivity of iron is less than that of copper, but once

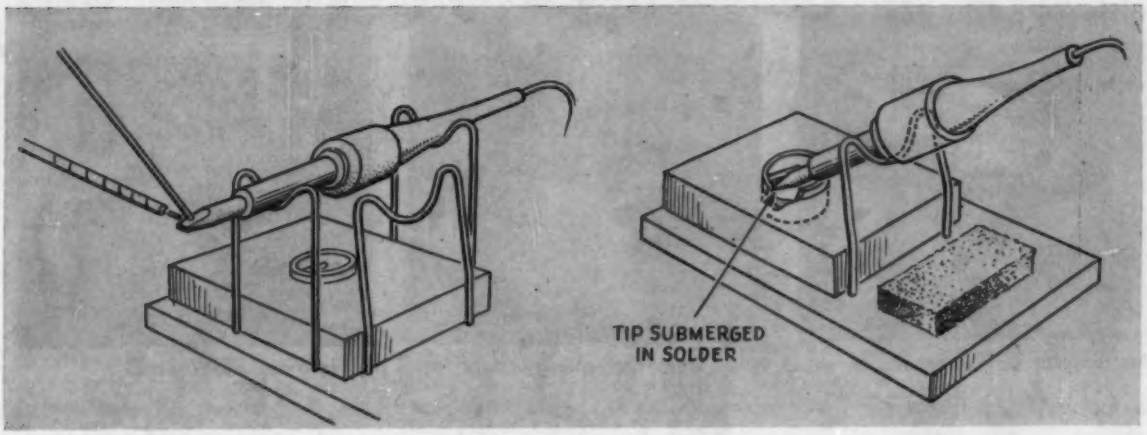
SOME TIPS ON CARE OF TIPS

With iron-coated tips . . .

DO	DON'T
. . . choose the proper original shape.	. . . file to clean.
. . . wipe off with wet cellulose sponge.	. . . file to reshape.
. . . keep tip well tinned when idling, use special soldering iron holder.	. . . wipe without re-tinning.
. . . clean tip with a small, stiff stainless steel brush.	. . . burn solder off tip.
. . . re-tin just above solder melting temperature.	. . . try to tin dirty tips.
. . . protect thin iron coating.	. . . overheat while cleaning.
. . . keep fully inserted in iron.	. . . overheat while re-tinning.
	. . . strike tip on holder.
	. . . forget to remove tip.
	. . . extend tip.
	. . . operate iron without a tip.

With copper tips . . .

DO	DON'T
. . . file to clean.	. . . tin dirty tips.
. . . file to reshape.	. . . overheat while cleaning.
. . . wipe with saturated sponge.	. . . overheat while re-tinning.
. . . keep solder on tip while idling.	. . . strike tip on holder.
. . . clean tip while cool.	. . . extend tip.
. . . re-tin just above solder melting point.	. . . clean on anything except wet sponge.
. . . re-tin immediately.	. . . leave iron idling without solder on tip.
. . . keep tip fully inserted in element.	. . . clean tip while hot.
. . . dress tip when necessary — at least twice daily.	. . . unplug without putting a puddle of solder on tip.
. . . use largest possible tip diameter.	. . . use short tips. Replace when one-half original working is depleted.
. . . unplug iron when not in use for periods of more than 25 minutes.	. . . file tip without unplugging iron.
. . . remove tip from iron at least once a day to clean inside the element.	. . . force setscrew against tip.
	. . . operate iron without a tip.



Wire holders for soldering irons: Holder (left) helps to position iron during tinning operations. Holder (right) prevents oxidation of iron-coated tips by keeping the tip submerged in a pool of molten solder

the tip is heated, this ceases to be a problem. An iron-coated tip is more difficult to clean when oxidized than a copper tip. However, oxidation can be eliminated by keeping the tip immersed in solder all the time it is heated but not being used (see sketch). The pool of solder contains a small heating element that maintains the pool temperature if the iron cannot supply the heat.

Additional fixturing (see sketch) at the iron holder will permit wire tinning at an assembly station. This is another reason for a built-in heating element. (The holder, with internal heating element is available from Hexacon Electric Co.)

Iron-coated tips are preferred in many applications for other reasons, too. The tip temperature can be controlled better than with a copper tip, which may be important at high-speed continuous operations. The shape and length of the iron-coated tip remain the same throughout tip life. And, with the holder (above right), the tip is always freshly tinned, assuring reliable soldering and efficient heat transfer. •

Machine cuts spar-deburring time 68%

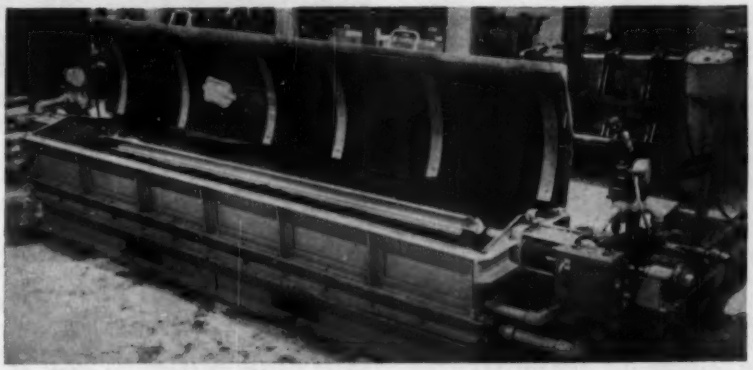
Most mechanical deburring machines are too small to handle pieces as long as airplane spars, so Boeing Aircraft Co, Seattle, Wash, which each month turns out over 1500 spars between 7 ft and 15 ft in length, decided to build its own.

Deburrs spar in 8 minutes

The prototype, called the Burr-Go-Master, deburrs an average spar in eight minutes, compared to 25 minutes for manual deburring. Some hand work is still required—at the ends, where spars are protected from abrasive by threaded holders, and for heavy extruded burrs.

Boeing expects to install a production machine that can handle all spars from 7 ft to 15 ft long. It will be a 16-ft-long, 16x16-in.-square, covered steel tub containing pressurized abrasive.

The prototype (see photo), covered with a rubber-lined lid, contains a pipe for coolant supply and a rubber bladder connected to a top-mounted pressure gage. Inside the tub is a rubber diaphragm which is inflated during the operation to put the abrasive under pressure.



Spar-deburring machine handles aircraft parts 7 to 15 ft long

Piston-rod extensions from opposed, end-mounted air cylinders protrude into the tub. Threaded fittings on the ends of these extensions are adjusted to hold the spar in compression between the cylinders. (Cylinders are in equilibrium and are controlled by solenoid valves.)

The tub, with the diaphragm deflated, is filled up to the workpiece level with a slurry of abrasive chips and cleaning solution. After the vibrators (mounted under the tub) have started the abrasive in vertical motion, the diaphragm is inflated with water to pressurize the abrasive against the lid.

With the abrasive pressurized to approximately 1 psi, the spar is reciprocating at a rate of 250-300 cycles per minute. When the operaton is completed, the diaphragm is deflated and the spar removed. •

Spectacular geyser results as shock wave from high-energy spark forms part into die under water

Spark forming works on stainless

"Underwater lightning" (electro-spark forming) is fast coming out of the laboratory stage and into actual production at four major metalworking companies—GE, Chrysler, Convair, and Republic Aviation. The metals: aluminum, titanium, stainless and high-strength steels.

General Electric's General Engineering Laboratory at Schenectady, for example, is forming titanium and stainless with a high-voltage spark which creates a shock wave that can bulge metal tubing or form flat blanks into dies. In most of the work, the shock wave is released under water or some other liquid so as to take advantage of liquid's ability to transmit shock.

Test parts formed by new process at GE's General Engineering Laboratory from titanium and stainless

Measured in joules

The spark is created by energy stored in a capacitor bank, which costs about 30c to 50c per joule to build (a joule is a measure of energy equal to about 0.738 ft lb), and GE's capacitor bank is rated at 27,000 joules.

GE currently uses a 35,000-volt spark to form pieces up to 10 in. diameter, 3/32 in. thick. Also successfully formed by GE, in addition to titanium and stainless, are columbium, and beryllium copper.

Dies are made of mild steel or epoxy—the blank is fitted to the die and the die cavity is evacuated to maintain 30 in. of vacuum in the cavity while the high-energy discharge takes place.

Coming: 54,000-joule bank

At present, GE in installing a 54,000-joule capacitor bank with voltages up to 100,000 for larger-scale tests. One of GE's product divisions is making plans to market the electrical equipment required for electro-spark forming.

First to report the process was Republic Aviation (*AM*—Oct 19 '59 p123). Recently, Republic announced a contract from the Marshall Space Flight Center to study the effect of electrical discharge forming phenomena as applied to the forming and shaping of metal. High-speed photography (1.6-million frames per second) will be used in checking effects of shock waves upon various workpieces. (See p57.)

Convair-Fort Worth, second to report work on the process (*AM/MM* Apr 18 '60, p104) has since developed a Hi-Vo-Pac package unit capable of storing about 15,000 joules and producing a 4000-volt spark. Convair's Dynapak Division is expected to market a package unit, perhaps later this year.

Explosive forming substitute?

Chrysler Corp's Missile Division has been experimenting with electro-spark forming, possibly as a way of forming Redstone missile parts now produced by explosive forming. Chrysler is said to have developed the process to the point where it has already been applied to shop practice on prototype parts.

Chrysler's work on aluminum includes parts up to 54 in. diameter. And stainless and high-strength steels have been punched, sheared, and pierced with special dies. SAE 1020 steel 1-inch-thick has been formed with excellent results, and some deep drawing has been done. •

Paint-priming hoods and fenders at Chevy-St Louis

Flow coating beats dip five ways

Flow coating has turned out to have several advantages over traditional dipping methods of applying paint-primer to auto body parts at Chevrolet-St Louis, where a new line primes such sheet-metal body parts as hoods and fenders. These parts, incidentally, are not sprayed, as are major bodies delivered from the Fisher Body plant next door.

The plant's flow-coat system, although it represents a considerable investment, has five distinct advantages over dipping:

- Requires less paint
- Reduces streaking
- Provides better rustproofing
- Eliminates uneven paint collection on the bottoms of parts
- Requires less hand labor

Flow coating works somewhat like spraying, except that the paint is deposited by fixed nozzles as the parts pass by on a conveyor. The paint falls on the upper areas of each part, then gravity-flows down to complete coverage and drip off.

Paint chemistry and mix are controlled to make the paint stick to all surfaces and also to make the surplus drain off—leaving only a specified coating thickness, even though no hand spraying is involved.

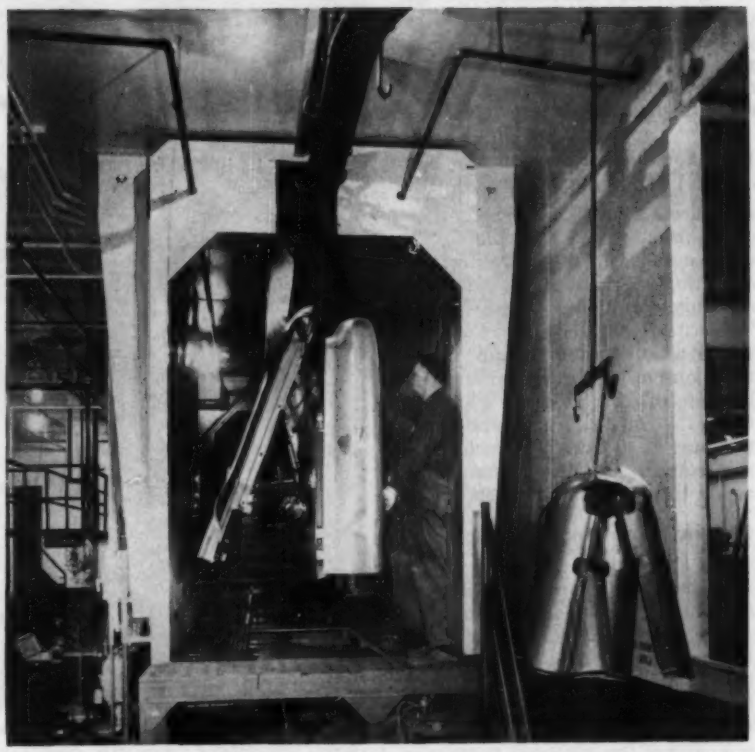
Two parallel lines

The new installation, built and erected by Dispatch Oven Co to Chevrolet specifications, actually includes two complete parallel lines, one for car parts and the other for truck parts. A pair of seven-stage washers is followed by a set of drying ovens and the two flow-coaters.

Overhead monorail conveyors carry the parts through alkaline cleaner, two rinses, zinc-phosphate bonderizer, clear-water rinse, and rinse in dilute chromic acid. The washer for car parts is about 250 feet long, but the washer for truck parts only 140 feet long, because the car-parts conveyor moves twice as fast as the truck-parts conveyor.

After passing through dry-off ovens, the parts enter the flow-coat machines, where paint is applied in a length of 4 feet—but drip-off lengths for the car and truck parts are 560 feet and 300 feet respectively.

One operator controls both the car and truck systems. •



Flow-coat machine is 40 ft long, including entrance, 4-ft spray section, and exit. Body parts are racked on monorail conveyor, hung for best drip-off angle

Timetable for seven-stage washers

Time	Stage	Temp	Car Spray Heads	Truck Spray Heads	Pressure psi	Total Flow (gmp) Car	Truck
1 min	Alkali wash	180F	504	264	30	2167	1135
½ min	Alkali wash	180F	264	144	30	1135	619
½ min	Hot rinse	160F	264	144	20	924	504
½ min	Hot rinse	160F	264	144	20	924	504
1 min	Phos-phate	160F	266 38	154 22	10 10	1463	847
½ min	Cold rinse		264	144	10	924	504
½ min	Chromic	160F	264	144	10	924	504
	Cold rinse		6	6	20	252	252

Robot comes to metalworking

Science fiction is becoming a reality at Consolidated Controls Corp where completely integrated robots are in pilot plant production. The robot, called Unimate, has been designed to replace human labor in routine, repetitive factory jobs, and the company is taking dead aim on this market, which it estimates is presently in the area of $120 million.

Designed like gun turret

The Unimate looks more like a gun turret than like the human being it is supposed to replace. The base contains all of the control and operating mechanisms: a new type of magnetic memory drum called "Dynastat"—the "brain" of the robot, and hydraulic actuator equipment—the "muscle." Mounted on the base is a central column from which extends the robot's arm. At the end of the arm is a "wrist," which bends and rotates like the human wrist, and a hand resembling a claw.

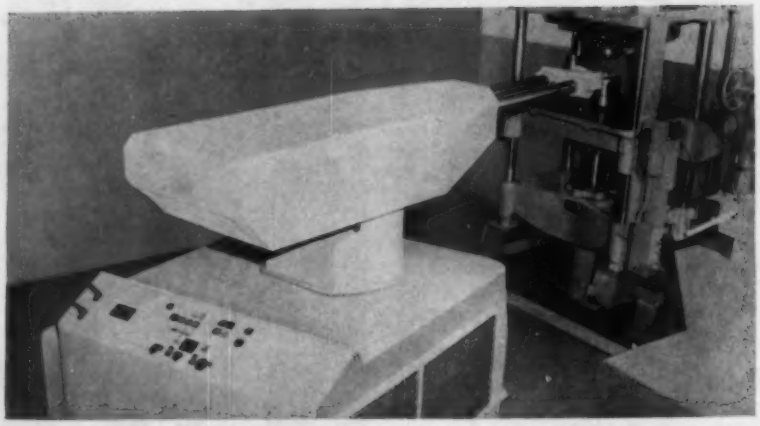
Plug-in operation

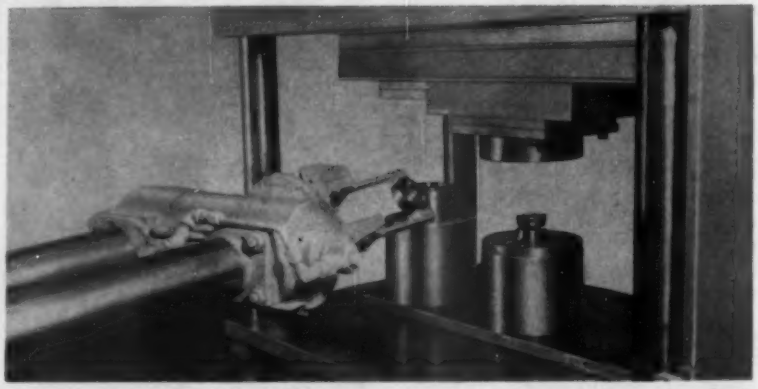
The Unimate needs only to be "plugged-in" to operate. Once the unit has been guided through the various steps of an operation by hand, with each key position along the path of operation recorded on the memory drum by means of a simple record button, the Unimate will repeat the recorded pattern indefinitely and unattended.

If a customer should want to transfer his Unimate from one operation to another, he merely moves the 2700-lb machine by fork lift to its new location and guides the arm, wrist, and hand through the new operation, recording the new program on the memory drum. The new program either erases a previous one or records on an unused portion of the 200 rows of memory units.

Consolidated Controls' president Joseph F Engleberger claims his robot is "not a manipulator but a true robot which duplicates the arm, wrist, and hand actions of a man." Going through its paces, the Unimate backed up Engleberger by performing three simple operations.

Unimate robots are being produced at the company's Bethel, Conn plant. They are production models of the prototype which has been developed during the past five years. Contracts for sale of the six robots are underway and the company eventually plans to produce 100 Unimates a month for industrial consumption. Estimated price is in the area of $25,000, but the company is aiming at an ultimate sale price of $15,000 for the present model.





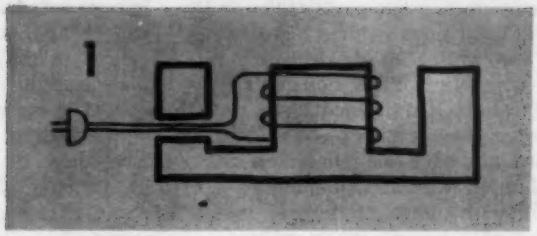
The Unimate robot places a billet in a two-stage forging press. Bottom: the robot's "hand" now rotates the billet to place it in the second stage of the forging operation. Unimate is said to duplicate human arm, wrist, and hand

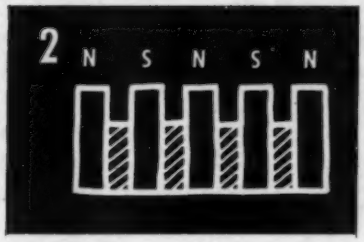
Consolidated Controls' first model has a maximum load capacity of 25 lb at normal operating speeds. At slower speeds the robot can handle 75-lb loads, still faster than a human could. The arm can be extended from 3 to 7 ft and can sweep through a horizontal arc of 220°; in a vertical plane, 60°. All told, it can grasp objects within a swept volume of 350 cu ft. The box-like base covers a 5 x 4 x 4½-ft area. Positioning accuracy of the Unimate is plus or minus 0.050 in., while the "hand" has a clamping force of up to 180 lbs at the end of 4-in. fingers. The clamping unit is pneumatically operated and clamping pressures can be varied. Other specifications: power requirements are 440 v, 3-phase, 60 cycle, 11 KVA; design life is approximately 40,000 operating hours; and maintenance costs are about $1300 a yr.

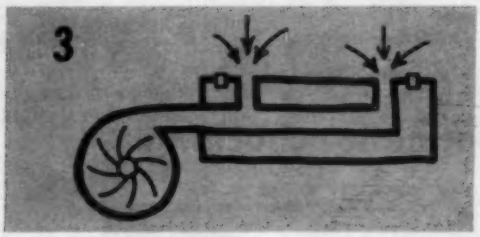
The future looks bright

Extensive marketing studies have been made by Consolidated Controls and Consolidated Diesel Electric Corp, parent company of CCC. Studies with 25 heavy industrial plants have indicated more than 300 applications in which robots of the Unimate type could perform more efficiently than human labor. "One automotive manufacturer sees more than 1000 applications in his plant alone," said Norman I Schafler, president of Consolidated Diesel.

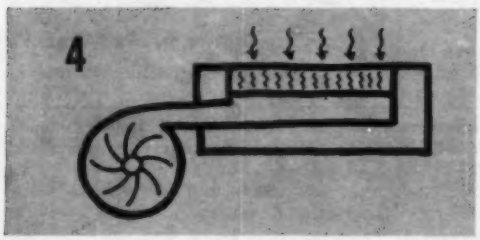
Typical applications envisioned for Unimate: press operations, welding, loading materials, transferring materials, forging operations, loading automatic lathes, packing cartons, assembly, inserting and tightening nuts and screws, spray painting. •





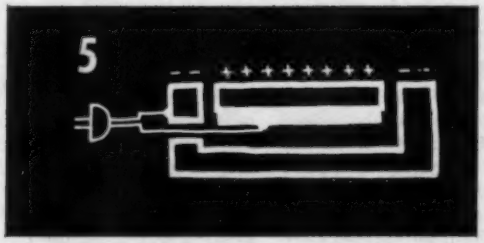


FIVE WAYS to chuck flat parts



By John Engelsted, president, O S Walker Co, Worcester, Mass

Extreme delicacy of missile age parts calls for a firm, distortion-free grip. Here are five chucking methods that fill the bill: (1) electromagnetic, (2) permanent magnet, (3) vacuum, (4) diffused vacuum, (5) electrostatic



American Machinist / Metalworking Manufacturing

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Five ways to chuck flat parts . . .

Today there are five different methods of chucking parts on a machine table without resorting to mechanical jaws or clamps of any kind. Why so many? One reason is that many missile-age parts are on the delicate side, and must be gripped without distortion.

Today's materials vary widely in physical properties—some are non-magnetic, others non-metallic, porous or even perforated. Requirements are thus different today, but five basic methods—some variations on old, standard methods, others based on new principles, can fulfil today's exacting demands:

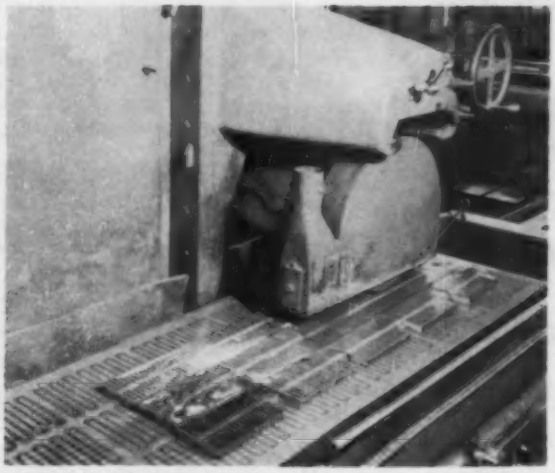
- Magnetic chucking with an electromagnet
- Magnetic chucking with permanent magnets
- Vacuum chucking with table ports or veins
- Vacuum chucking with a diffusing screen
- Electrostatic chucking

Electromagnetic chucking, patented in 1896 by O S Walker, is still being improved through better designs and more useful application techniques. Permanent-magnet chucks and vacuum chucks were widely applied before World War II, though advances in the last decade have greatly broadened their usefulness. Diffused-vacuum and electrostatic chucking are more recent developments.

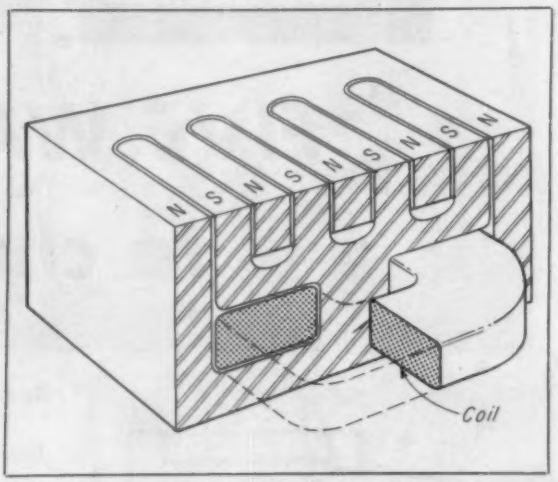
In addition to the five basic methods, problems have been solved by combining permanent and electromagnets in one chuck, or vacuum chucking and electromagnetic chucking simultaneously in one unit.

The real question is, which technique works best, under what conditions, for what kind of parts? Here are the advantages and limitations of each:

Electromagnetic chucking



Standard electromagnetic chuck is made up in sections, a coil to a section, and with multiple pole pieces branched out



to the surface from the core through the coil. Spaces between poles are filled with stainless, non-magnetic metal or plastic

This is the old standby, applied initially and traditionally to surface grinders and—to a growing extent—to millers, planers and lathes. This system may be more elaborate in terms of electrical conductors and control equipment than mechanical jaws, but it is reliable, familiar, quick-acting, and positive. One advantage: Ferrous parts can be gripped tightly, insuring parallelism with the chuck surface without any encumbering mechanical clamps.

Setup is usually quick and simple, allowing more actual productive cutting hours at the machine. Fixtures can be applied to locate parts so that particular surfaces can be machined, and the magnetism will hold both fixtures and parts in place. Tools or wheels can be worked to any depth in the parts, at any position, and can even cut down the sides to the table surface itself.

Standard power units

The power supplies are not complicated. Well-engineered standard units are available today for almost any application. Primarily, these are rectifiers for changing alternating current from plant power lines (which might be anything from 110V to 550V) to a direct-current voltage of 110V or 220V.

For chucks up to approximately 8 x 24 in., a rectifier unit with a built-in switch or a separately mounted switch, as desired, is often sufficient. The switch is simply a means for turning the direct current on and providing a short reverse pulse for ease of removing the workpiece.

For larger chucks or more critical applications, in addition to the basic rectifier, automatic switching provides a series of delaying reversing pulses that effectively reduce residual magnetism in the workpieces to a low level. When desired, rectifiers can be controlled as to the amount of current output to provide adjustable holding power on the chucks.

Originally, magnetic chucks were designed to operate with very low DC voltages, such as 6 or 12 volts, which were readily available from battery power sources. However, after the first World War, the techniques had advanced to the point

where more efficient higher voltages could be effectively controlled.

These higher voltages provided the same or better holding power with much lower currents. As a result, cables connecting the chuck to the power unit and the control switching gear became more efficient, because much power loss was eliminated with the reduction of current flow.

Since then, electrical and magnetic designs of chuck circuits have been continually improved to reduce the I^2R power loss and consequent heating which were once a problem on magnetic-chuck installations.

Modern low-current, high-voltage, chuck and power-supply combinations give efficient and trouble-free performance for many years.

High holding power

Holding power of the electromagnetic chuck is the highest of any non-mechanical clamping device, when the workpiece section is sufficiently heavy. Direct hold-down forces of over 150 psi, with resistance to slip up to 30 psi, are obtainable.

This resistance to slip may not appear sufficient, but it generally presents no problem, because it can be augmented by blocking the work with magnetic blocks or mechanically attached side rails or stops.

On circular chucks, it is quite often the practice to pilot the work when a center hole is available, and to use retaining rings which may be magnetically or mechanically attached.

Cleanliness is important

Almost as important as good blocking, is the cleanliness of chuck and work mating surfaces. Metal particles, dirt (or even scrap paper between the bottom of the work and top of the chuck) may reduce holding power by several times. Similarly, available holding force is adversely affected when the mating surface of the workpiece is rough or does not contact the chuck squarely.

Magnetic-pole shape and size are important, although general-purpose chucks are built in sizes and patterns to handle most common parts efficiently. The magnetic field is maximum flux density that should be fully utilized to grip the part.

If the field extends completely through the work and beyond it (as on a coarse-pole chuck with thin-gage stock mounted), magnetic lines of flux extending beyond the workpiece not only subtract from holding power but tend to throw out a wide field that may magnetize the cutting tool and chips.

Such a setup may also damage a cutter and keep chips in the cutting area where they may drag on the work and ruin a machine surface.

A quick and helpful way of checking excessive magnetic flux penetration through and above the workpiece: Feel how much attractive force is exerted on another piece of steel placed on top of the work

Handling large parts

A large heavy part, on the other hand, should not be mounted on a chuck with fine pole separations—because a tight magnetic field will not penetrate the work fully and cannot hold the work with complete security. Large parts should be gripped with coarse poles, while smaller, thin parts should be gripped with proportionally finer poles.

Standard-pole-design rectangular chuck and radial-pole design circular chucks are the only types of electromagnetic chucks that have all their poles directly connected by magnetic material to the coil cores, where magnetism is induced. These designs may have more than one pole connected to the same coil core, but each pole is a "major pole" as it goes directly to the magnetic source without traversing non-magnetic gaps.

The normal designs of transverse bar-pole and longitudinal bar-pole chucks, as well as rectangular and circular design concentric types, have multitudes of poles at their work surface but they are not all "major" poles.

Instead, the major poles only occur at intervals among the visible pole pieces, with intervening minor poles providing a magnetic gradient between them. The non-magnetic gaps may consist of any type of non-magnetic material.

The selection of this gap material is largely a matter of providing a non-magnetic filler, which should be dimensionally stable and sufficiently hard to resist handling abuse. It should also be machinable so the chuck surface can be re-dressed.

In transverse-bar-pole design, it is helpful to know which are the major poles so the workpieces and blocking material can be located most effectively.

In a typical design, the pole pieces on such a chuck may be ¼ in. wide, separated by 1/16-in. gaps of stainless steel. All poles look alike at the surface, but the major poles may only occur at 2-in. intervals, thus providing a ratio of perhaps five minor poles between each pair of major poles.

The major poles can be determined by turning the chuck on, taking a small piece of steel in hand, and holding it perhaps ¼ in. away from the surface of the chuck while sliding your fingers along the chuck lengthwise.

The test piece is kept away from the surface of the chuck to prevent direct holding force, but is held close enough to the surface so that a force induced by the major poles can be felt as the test piece passes over them. A small magnet (either Alnico or ceramic), can test for polarity of the "major" poles.

Maximum holding areas

Maximum holding occurs **between** the major poles, while weak areas of holding exist directly above the poles themselves. Thus, the areas above the major poles may sometimes be avoided in critical holding applications. The major poles may be covered with flux-conducting steel pieces, which help lead the flux across the intervening gaps to minor poles actually in contact with the work.

The same situation occurs with longitudinal bar-pole chucks, and with concentric-gap chucks. In small designs of longitudinal bar-pole rectangular chucks, the two sides of the chuck may be the major South poles of the chuck, while the only major North pole runs lengthwise down the center of the chuck between the side walls, with only minor poles in between. On larger chucks, additional major poles are provided.

Chucks with major and minor poles are not necessarily inferior. Major poles separated by a number of minor poles effectively diffuse the flux throughout the work surface of the chuck to get maximum magnetic coupling to workpieces — particularly when they are not thick enough to directly absorb all the flux produced by the major poles alone.

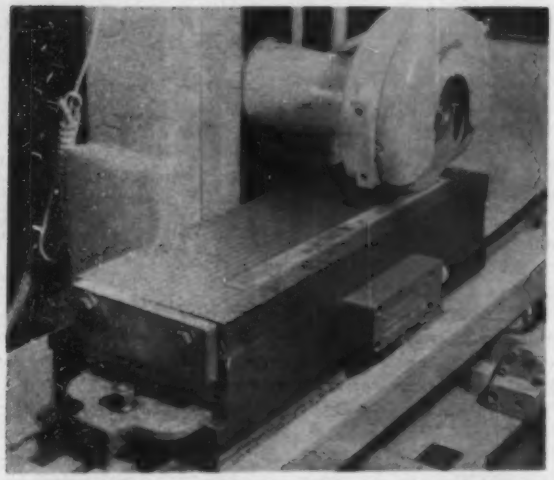
Once construction and function of this type of chuck is understood, many workholding problems caused by misapplication can be overcome.

Flux absorption

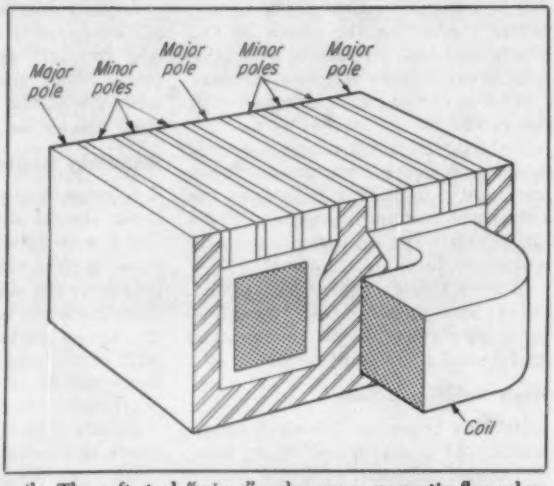
Maximum holding power is determined by how much **total magnetic flux** is absorbed by the workpiece. This may not be the largest number of pole pieces crossed (there is usually a choice between pole size and total number of poles). Blocking bars improve gripping action, by preventing the work from shifting along the table, and by bringing in extra magnetic flux from poles beyond the edges of the work.

Five ways to chuck flat parts . . .

Permanent-magnet chucking



Longitudinal bar-pole chuck is a single-coil unit with "major" poles in the center and on the outside edges, with floating "minor" poles between. Larger chuck may have 2 or more



coils. The soft-steel "minor" poles carry magnetic flux when a workpiece indices a complete field by spanning the "major" poles

Since the introduction of Alnico and ceramic magnets, another kind of magnetic chuck has been available. This permanent-magnet chuck generally requires less table height, may cost less, and weigh less, and requires no power. Consequently, it generates no heat.

Such a chuck is turned on and off by physically moving a magnetic assembly inside the chuck with an external lever.

Reducing magnetism

Several different principles may reduce magnetism to a low point, or (preferably) bring it right down to zero and slightly beyond to cut down on residual magnetism.

The original Alnico chucks used an eccentric and a connecting rod actuated by the handle to slide an assembly of magnets and internal pole pieces into short-circuiting position when the chuck was turned off. This principle, still used today, does not normally bring the magnetism at all poles on the chuck surface fully to zero or beyond. This may leave "sticky" areas on the chuck top, even when turned off. In addition, with this design a secondary (stray) field of magnetism is always present around the sides and bottom of the chuck. This is not turned off at any time.

An early technique which overcame objections to shunting employed "magnetic compensation." In this case, the chuck body contained a set of fixed magnets in parallel with a set of rotatable magnets in the magnetic circuit. The latter set turned upside down when the handle was rotated so that the second set bucked out the magnetism of the first set when the chuck was turned off.

By making the rotatable magnets stronger than the fixed ones, polarity at the work surface of the chuck could actually be reversed to reduce residual magnetism.

More recently (because of ceramic magnets) chuck designs have magnets in such a position as to feed poles at the top of the chuck much more directly. High coercive force (three times as high as that of Alnico) makes it possible to use magnets only ¼ in. long, rather than three and four times that length.

Positioning magnets

Magnets can be placed directly between parallel poles in the chuck, while still maintaining reasonable pole spacing. The most effective on-and-off design has a fixed set of magnets in the top plate of the chuck between parallel poles, with a similar pack of stronger magnets arranged in a movable assembly inside the chuck.

These dimensionally match the magnets and poles in the top of the chuck in spacing and layout. The movable assembly is shunted back and forth with an eccentric and a connecting rod actuated by the handle. When the assembly is moved one pole pitch (or approximately ½ in. in most common designs) the stronger magnets in the movable assembly overcome the magnets in the top plate and reduce the magnetism at the top to zero and slightly beyond.

Eliminates stray fields

The ceramic magnet chuck not only provides pole reversal for minimum residual magnetism, but completely eliminates external secondary or stray fields, which would magnetize nearby machine components and cutters. For the first time, powerful chucks with fine pole pitches may thus be used for general work. In addition, a completely balanced magnetic circuit is established, with each pole a major one of exactly opposite polarity to its neighbor.

Side benefits

A useful side benefit of this design: A cutter rotated over such a chuck (on a milling machine) is automatically demagnetized. Demagnetization occurs as each of the cutter teeth traverse over poles of opposite polarity. This is repeated in a diminishing way as they rotate up and around the cutter away from the chuck top. Rotary ceramic-magnet chucks, with somewhat the same construction, also provide this feature—automatically demagnetizing the tools and toolpost, and even ad-

jacent machine components if used, for example, on a lathe.

These new ceramic-magnet chucks have considerably more power than the earlier metal magnet type because they employ flux focusing. Oddly enough, none of the magnet materials, whether Alnico or ceramic, will themselves conduct as much magnetism as soft steel.

Because maximum flux density at the pole of any permanent magnet is lower than it should be for maximum holding force, it is desirable to concentrate or focus it to a higher density (as holding forces increase with the square of the flux density). Doubling the flux density will give four times the holding force for the same pole area.

No designs have been developed to focus the flux of Alnico magnets in chucks, because the length of magnet makes this technique highly impractical.

Flux focusing

Flux focusing works best when the work covers rather large chuck areas. If just a few small parts are to be held, either the ceramic design or conventional Alnico types will probably do the job, because automatic flux focusing in the workpiece gives good holding power. The magnetic flux travels in from the sides to the workpiece from the exposed area of those poles not in contact with the work.

Magnetic areas

The work area of a permanent-magnetic chuck, for several square inches immediately adjacent to the handle position, has less magnetism than the broad central areas of the chuck. This is unavoidable because some space is needed internally for the operating mechanism.

Normally, sufficient magnetism is still available in this area for average holding requirements, but it is good to avoid this area when the holding problem is critical. Similarly, the very last poles at either end of the chuck have less magnetism than the average, again because of limitations of internal space for inclusion of magnets.

It is thus best to work in the central area of any permanent-magnet chuck when difficult holding problems are involved. Incidentally, the ceramic chuck will also hold effectively on the sides of the top plate. This is handy for edge-grinding jobs, where pieces are to be squared.

Choice of a permanent or electromagnetic chuck depends upon the individual application. An electromagnet is bound to develop some heat (with power supplies from 50 to several thousand watts, heat is inevitable), but the chuck will reach temperature equilibrium under constant conditions and will stabilize.

Permanent-magnet chucks, on the other hand, may have some possible minor internal distortion because the magnets go through physical motion —are displaced within the magnetic chuck. However, if the chuck is dressed with the lever in the "on" position, the same conditions will exist as when it is being operated with a workpiece, and any loss of precision should either be minor or nonexistent.

Rule of thumb

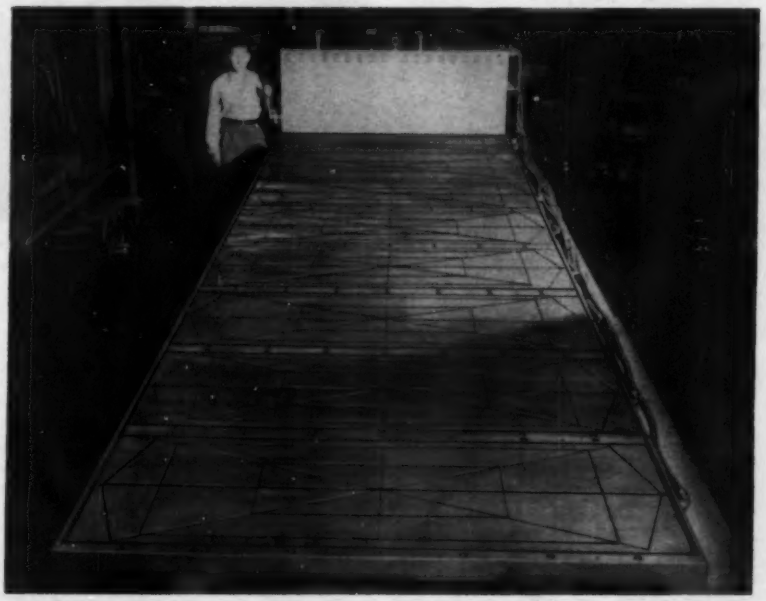
As a general rule, an electromagnetic chuck is probably the best choice for large work, a permanent magnet best for small work, with fielder's choice for sizes in between. Because of cost, convenience, flexibility and general reliability, magnetic chucks of both types are preferred for any work that can be gripped magnetically, unless there are special problems that only another chucking method can solve.

Vacuum chucking

Skin and spar mills, and applications where in brass, aluminum, and other non-magnetic materials must be gripped flat without any mechanical clamping or blocking, require vacuum chucks. These are for fairly large areas of work surface, because maximum available pressure is around 12 to 13 psi. The theoretical limit is 14.7 psi (with 30 inches of mercury). Usually about 26 inches of mercury is tops—a more perfect vacuum would cost more and add little to holding power.

Holding force depends entirely on the work area in contact with the chuck, and even though pressure appears low, it only takes an area of about 10 x 16 in. to approach a ton of total holding force. In addition, conventional vacuum chucks with rubber seals have a higher proportional resistance to work slide (up to one-third of the pressure normal to the table) which is an advantage in holding the work securely. The work may be blocked for even greater stability.

One application involves gripping



Vacuum chuck for large, flat sheets is divided into eight sections, with vacuum drawn from the center of each through radiating and connected veins. This method achieves almost a ton of holding force per square foot

thin, round disks on a large lathe, if the outside edge of the disk is to be machined. Because such work is light and not rigid, heavy cuts are not taken. Therefore the chuck need not exert high pressure to hold the work against tool pressure. Here again, the large area of the disk provides a large total gripping force, even with low pressure.

Once a vacuum chuck is set up (together with the vacuum pump and valve system and filters), it is a fairly flexible holding system for many parts of similar nature. The usual grid of holes or veins connected to the vacuum pump can be controlled by stop-off plugs or by a manifold control that shuts off those holes not covered by the work.

The area around the work not shut off is then masked by nonporous sheets of plastic or rubber, or veins can be sealed with putty. It is essential that the outside contour of the work be sealed off with some flexible material to prevent air entry under the edges of the work.

On chucks designed for one kind or family of workpieces, recessed sealing rings are provided to fit the shape of the piece without further masking. A rotary chuck might have concentric sealing grooves into which the sealing material is placed to match the size of the work mounted.

Cleanliness is important in a vacuum system, hence the filter requirement. Standard vacuum systems are available — pumps or ejectors. The pump method is most efficient, but it is subject to dirt problems, and the filters must be properly maintained. By far the largest number of vacuum-chuck installations today are with pumps.

The ejector system (operated by venturi on an air line) is used occasionally where workpieces are rapidly loaded on and off the machine and great quantities of coolant and chips may be inhaled into the vacuum system.

Although the ejector system is less expensive from an initial-cost standpoint, it is rather inefficient in its use of air and requires a compressor system 5 to 10 times as great as the equivalent vacuum-pump capacity.

Diffused-vacuum chucking

A new addition to the vacuum principle, the diffused-vacuum chuck, so far has worked out experimentally on small chucks, but is being applied and developed more fully into a major chucking method.

The chuck is often a block of porous ceramic material through which vacuum is drawn by pump. The porosity and type of ceramic material must be correct to give the desired air flow. It provides a flat surface on which thin parts—sheet metal, plastic circuit-board stock, and such light work—can be gripped with 10 to 12 psi.

Diffused-vacuum chuck works with a porous ceramic top plate and special paper that masks uncovered areas but passes vacuum under the area of the part

Paper diffuser-filter

It is essential, however, that the work surface of such a ceramic diffused-vacuum chuck be covered with a specific grade of paper between the workpiece and the chuck. This paper serves two purposes: (1) to diffuse the vacuum so the pump will be able to maintain sufficiently high vacuum, and (2) to act as a filter and keep the ceramic chuck surface itself from being contaminated with grit and coolant.

For wet grinding, a high-wet-strength paper of a special grade provides the necessary stability and vacuum action, even when splashed completely with coolant.

The diffused-vacuum principle eliminates masking of those chuck areas left open by workpieces of irregular shape or with perforated holes. This system is thus good for parts that cannot otherwise be vacuum-chucked because of shape or the variously sized inside openings.

When large areas of diffused vacuum chuck are employed in a system, the size of pump can be considerably reduced with various masking techniques. These are not nearly as critical as for an ordinary vacuum chuck, and consist merely of painting or spraying the exposed area of paper with quick-drying wax or lacquer—with the vacuum turned off. Anything that will serve to make the paper less porous around the workpiece will do the job. Sheets of plastic can be used for repetitive long-run production.

The diffused-vacuum chuck, which resists work sliding as well or better than other gripping methods, has often provided the only means to do certain jobs. In addition to ceramic chuck plates, porous-sintered metal plates now being developed are more easily re-dressed by the machine to maintain flatness and parallelism. Various other constructions of fine mesh and grid have also been applied successfully.

Electrostatic chucking

Also designed for holding non-magnetic thin parts of irregular shape, the electrostatic chuck provides more holddown force than vacuum (up to 30 psi), allowing heavier cutting or holding for light and small-area parts which cannot be gripped reasonably well with a vacuum or diffused-vacuum chuck. Initial cost is higher than that for most chucks, however.

Electrostatic chuck holds brass thrust washers, exerting up to 30 psi. Other jobs include holding 0.005-in.-thick slitting saws for precision face grinding

Mostly for grinding

Most applications today are for grinding. For example, very thin slitting saws can be produced from stock blanks on an electrostatic chuck without losing flatness or thickness uniformity. Again, the total holding force is a direct function of the surface area in contact with the chuck.

Grips any contour

Electrostatic chucks will also grip parts with integral holes, regular or irregular, and of any contour. It is, however, essential that the workpiece be reasonably flat on the surface contacting the chuck.

Otherwise, holding power would be reduced if the surface were to deviate to any extent from that of the chuck top.

The electrostatic chuck has a thin plastic coating on the top of a special ceramic plate. A special plastic solution is painted on the ceramic top, allowed to harden, then ground to a thickness of 0.001 in. Workpieces are then placed on this plastic coating, which is sufficiently hard to insure accuracy.

The parts must be dry—so must everything else in association with the chuck. The chuck's work area is first covered with a special oil, then electrical ground connections are made to each workpiece by end or side stops or spring fixtures. When multiple workpieces are to be ground at once, they are slid into contact with each other to assure that each piece is electrically grounded.

When the chuck is turned on, an extremely high electrical charge is developed under the plastic sheet, through the ceramic. The plastic sheet acts as a dielectric between the top of the ceramic and the grounded workpieces to build up an effective holding force.

Ingenious design eliminates all danger to the operator and guarantees trouble-free operation. Accessories (such as an effective coolant filter and a dry-box for conditioning the workpieces prior to checking) are available. The coolant is an oil, because water solutions would destroy the holding power of the chuck.

Best chucking methods

These five chucking systems may overlap, but each has a definable family of workpieces that it can hold most efficiently:

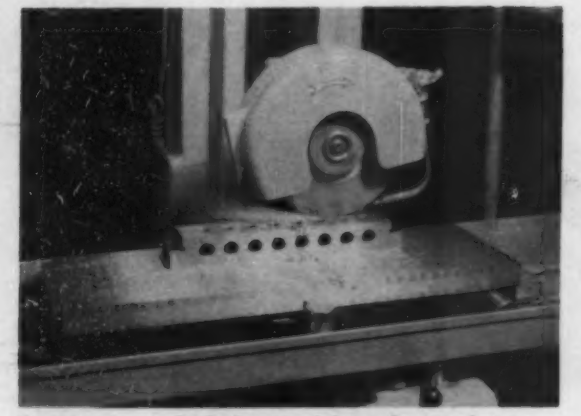
- Electromagnetic chuck: Ferrous, large, heavy parts (also medium sizes)
- Permanent-magnetic chucks: Smaller ferrous parts
- Vacuum chucks: Non-magnetic (and even non-metallic) parts of continuous surface — preferably those with a large area in relation to the cutting forces involved, and of somewhat regular shapes to simplify the masking.
- Diffused-vacuum chuck: Small non-magnetic (and non-metallic) parts, with holes and irregular shapes and of sufficient area to build up vacuum force in proper relation to cutting forces involved.
- Electrostatic chuck: Medium and small magnetic and non-magnetic parts (but which can conduct electricity or can be made to conduct electricity by application of metallic film) and applications requiring fairly high gripping pressure per unit area of work surface.

Tips on magnetic chucking

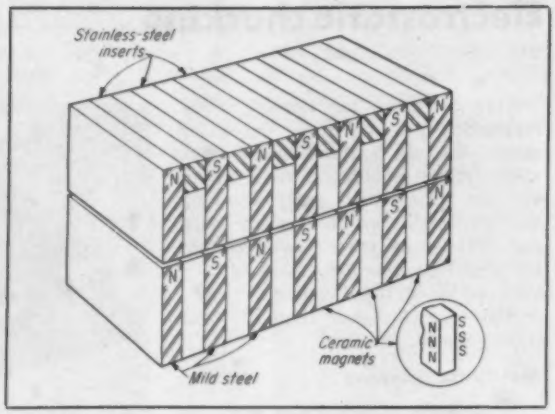
Two basic magnetic factors, "saturation" and "flux density," are little understood or, at best, not fully appreciated. Both are important in deciding how to grip magnetically.

About saturation

Saturation (the point where a magnetic material has absorbed the maximum possible amount of magnetic force) depends upon the magnetic characteristics of the material, and upon its shape and size. Saturation is seldom reached in practice because as it is approached, the amount of energy required to produce more magnetic effect goes up rapidly. However, if more holding power is vital, a little more is always obtain-



Ceramic-magnet chuck shown at left is a laminated structure made up of magnets that are polarized through their short dimension. Mild steel bars act as surface poles. The bottom layer of magnets, which is stronger than the top layer, is



lever-shifted so as to augment, or even overbalance, magnetic force for on-off action. Chucks such as these generally cost less than other permanent-magnet types, weigh less, and require no power

able up to the point of saturation, although the last bit of holding power is expensive.

The term "permeability" comes in here. (The numerical ratio of magnetic flux density produced, divided by the intensity of the magnetic field applied to produce this flux.) For air this value is 1; for any magnetic materials it is higher than 1, except that it drops down to 1 as a limit as saturation is approached.

Thus, the maximum possible holding power for a workpiece made of soft steel is a bit over 200 psi at the point of saturation. No electromagnet, no matter how large and powerful, can exert more force on the workpiece, regardless of shape and size.

Most often a chuck has a definite holding limitation, based not on the saturation point of the workpiece, but on the amount of energy it will convert into flux force, or on the saturation of magnetic parts within the magnet itself. Good chuck design keeps this last factor from being a serious limitation.

Flux density

Flux density, measured in Gauss can be compared roughly to fluid pressure measured in psi. However unlike hydraulic devices (where force is directly proportional to pressure), magnetic holding force is proportional to the flux density squared. Therefore it only takes about a 40% increase in flux density to double the holding power. Any increase in flux density is consequently very worthwhile when greater holding power is required.

But the magnetic characteristics of conducting materials vary. Permanent-magnet materials such as Alnico or magnetic ceramics do not conduct magnetism as readily as soft steel. For this reason, the amount of flux density available directly from the pole of a magnet is lower than it should be for most effective holding.

Therefore, it is desirable to concentrate the flux through soft-steel pole pieces (as on a magnetic door latch) to increase the flux density and improve holding power. Ceramic magnets, particularly, lend themselves to flux focusing, which increases flux density six to eight times.

Magnetic hardness

Low-carbon steel is a magnetically "soft" material, which can be easily magnetized in a field, but will not retain much magnetism. Materials used in permanent magnets, such as Alnico and hardened high-carbon steels, however, are magnetically "hard". They are difficult to magnetize, but they retain that magnetism once it is established.

Magnetically soft materials should be applied as work blocks on a chuck, when they can be arranged to bring in more flux to retain the workpiece. But if mechanical hold stop blocks need simply absorb magnetic flux without improving holding power, they should be non-magnetic (brass or stainless steel) and clamped into position.

If the workpiece is a "hard" material, it can be demagnetized after chucking by reversing the chuck to reverse the magnetic field. In an electromagnetic chuck this is done by shooting reverse current through the coils (just for a second). In a ceramic chuck, the mechanism is designed to take the magnetic force down beyond zero to create a reverse field that will release "soft" workpieces—and will even "pop" them free.

Residual magnetism can be useful: It holds the work to an electric chuck even with power "off" to allow repositioning and adjusting, or holds the work sufficiently when a light grinding cut on a springy part is required.

Special chucks combining the features of electric and permanent chucks are available with some internal parts made of magnetically "hard" materials. These increase the residual magnetism in the chuck, holding the work firmly even when the chuck has its electrical power cut off. •

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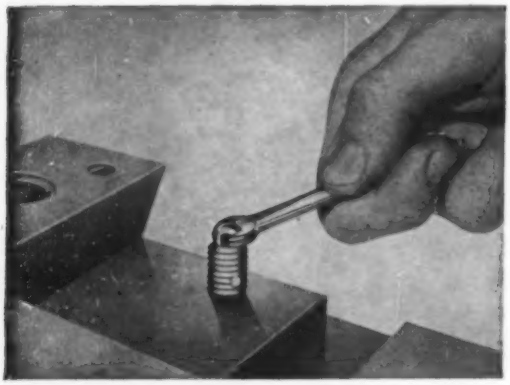

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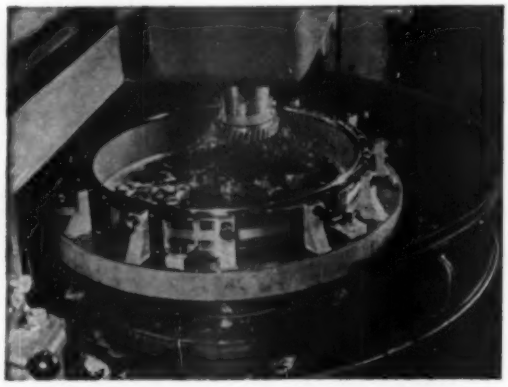

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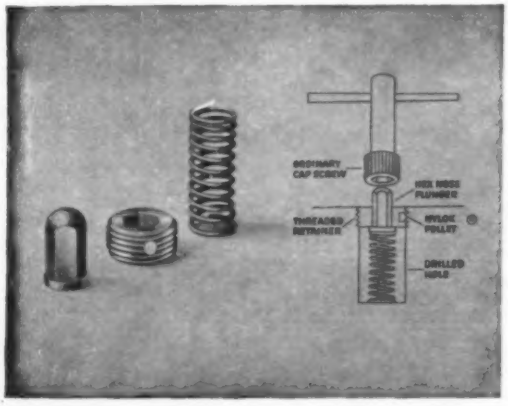

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Laminated Plastics and Fiber—III

Hole-machining operations on these materials are not difficult if simple precautions are observed. Notes on drilling, tapping, reaming and broaching are given from production experience with fabricating non-metallic materials

By John T Bishop, production manager,
Continental-Diamond Fiber Corp, Newark, Del

Drilling

A hole drilled in a laminate will shrink or close in. Unless reaming will be done, always drill a hole 0.002-0.004 in. oversize. Automatic feed is preferred because light, uniform pressure is required. Chipping of the lower surface can be controlled by backing the work and reducing feed pressure at break through. HSS drills, with wide, polished flutes make the best tools for drilling laminates. The wide flutes provide maximum chip removal and the polished surfaces prevent drilling dust from accumulating.

An air jet frequently does a better job of cooling than conventional liquid coolants. The latter tend to mix with drilling dust to form a paste, which generally hampers the operation. If air is used, a thin, high-pressure stream gives the best results. But drilling speed must be cut back to about 10,000 rpm max. and 200 to 350 sfpm, depending on grade and thickness.

Carbide drills with polished flutes and slow helix are particularly well suited to drill glass-base laminates. For through-holes in thin sheets, grind the point to a 55° included angle; 90° is satisfactory for drilling in a thick sheet. Cutting speeds of 150 to 300 fpm, with a feed of 0.002 to 0.003 ipr should be used. Lift the drill regularly to keep the hole clean of chips.

Working with vulcanized fiber requires drills with the same wide, highly polished flutes, steep helix, and narrow web as used for laminated plastics.

The highest speed that won't burn the drills or the fiber is recommended. A No. 60 drill at 10,000 rpm or a ¼ in. drill at 2500 rpm are typical drill speeds.

Hole shrinkage is also experienced when drilling vulcanized fibers, and the same remedial actions can be taken. In addition, you should avoid drilling parallel to the fibrous structure. If this must be done, clamp both sides of the work and lift the drill repeatedly to clear the chips.

Tapping

The resiliency of most laminated materials demands that special attention be given to rake. The tools should have up to 10° negative rake angle, depending on the thread diameter, pitch, and finish required. A positive rake results in a weak thread.

For threading laminates, the most effective tool is a ground HSS tap with three flutes about 0 0015 to 0.002 oversize. A 75% thread with a Class 2 fit is the maximum.

When cutting glass-base laminates, a 5° negative rake on the front of the land minimizes binding or stripping as the tap is removed. Nitrided, chromium-plated taps do the best work on the glass-base materials. Chamfer the hole to prevent lifting of the laminations by the entering tap.

A 75% thread with Class 2 fit is the maximum obtainable in vulcanized fibers. Negative rake of up to 10° is recommended for thread strength. A positive rake on a tap, die, or single-point tool will cause the tool to dig in, crowd its lead, and cut a weak thread.

Moderate application of light machine oil facilitates tapping in vulcanized fibers. The hole should be 0.002 to 0.004 in. larger than its counterpart in metal, and a tap should be 0.004 in. oversize for best results.

Broaching

Because of the laminated structure, the following specialized procedure should be followed in all broaching operations:

To cut across laminations, back up material with a mild-steel or brass plate. This should form a slide fit with the last cutting tooth of the broach. Such a procedure prevents fraying or breakout.

When cutting parallel to the laminations, use a fixture to apply pressure at right angles to the structure. When broaching laminates, take a cut of 0.001 to 0.005 ipt. When broaching vulcanized fiber, the cut can be from 0.02 to 0.03 ipt. Pitch can range from ¼ to ¾ in. depending on grade and thickness of the material being broached.

Reaming

The laminated structure makes it important to ream across the material wherever possible. As in broaching, a fixture should be used to apply pressure to the structure when reaming parallel to the laminations.

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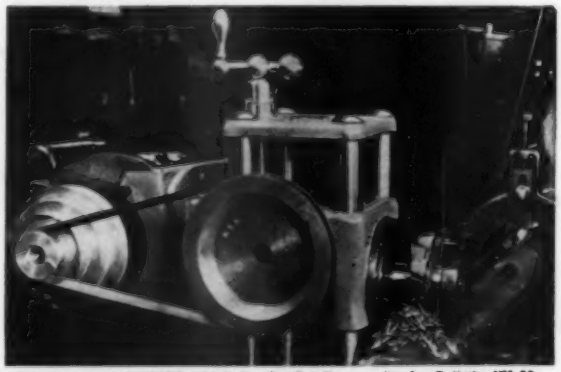

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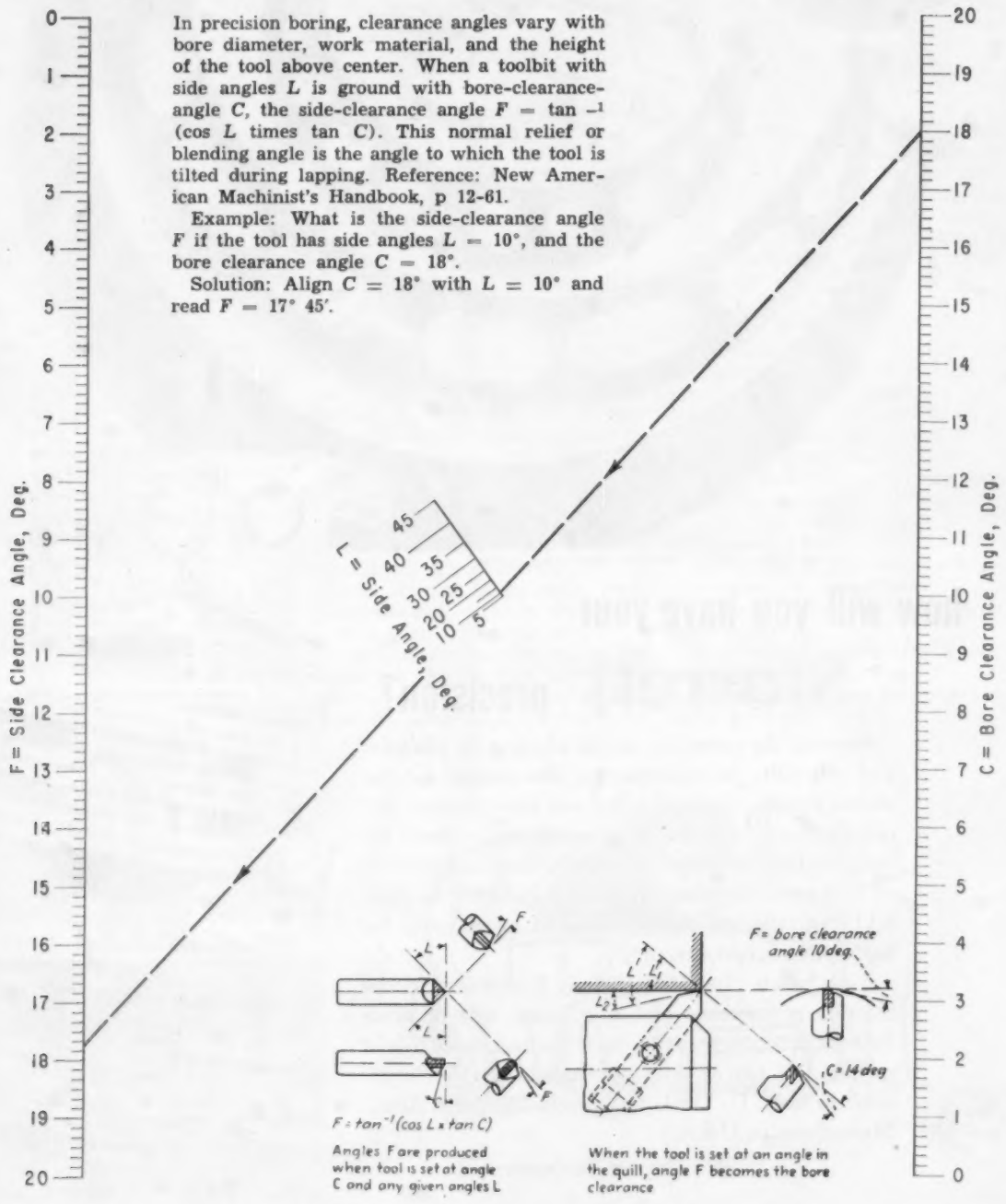
"Blending Angles" for Precision Boring Tools

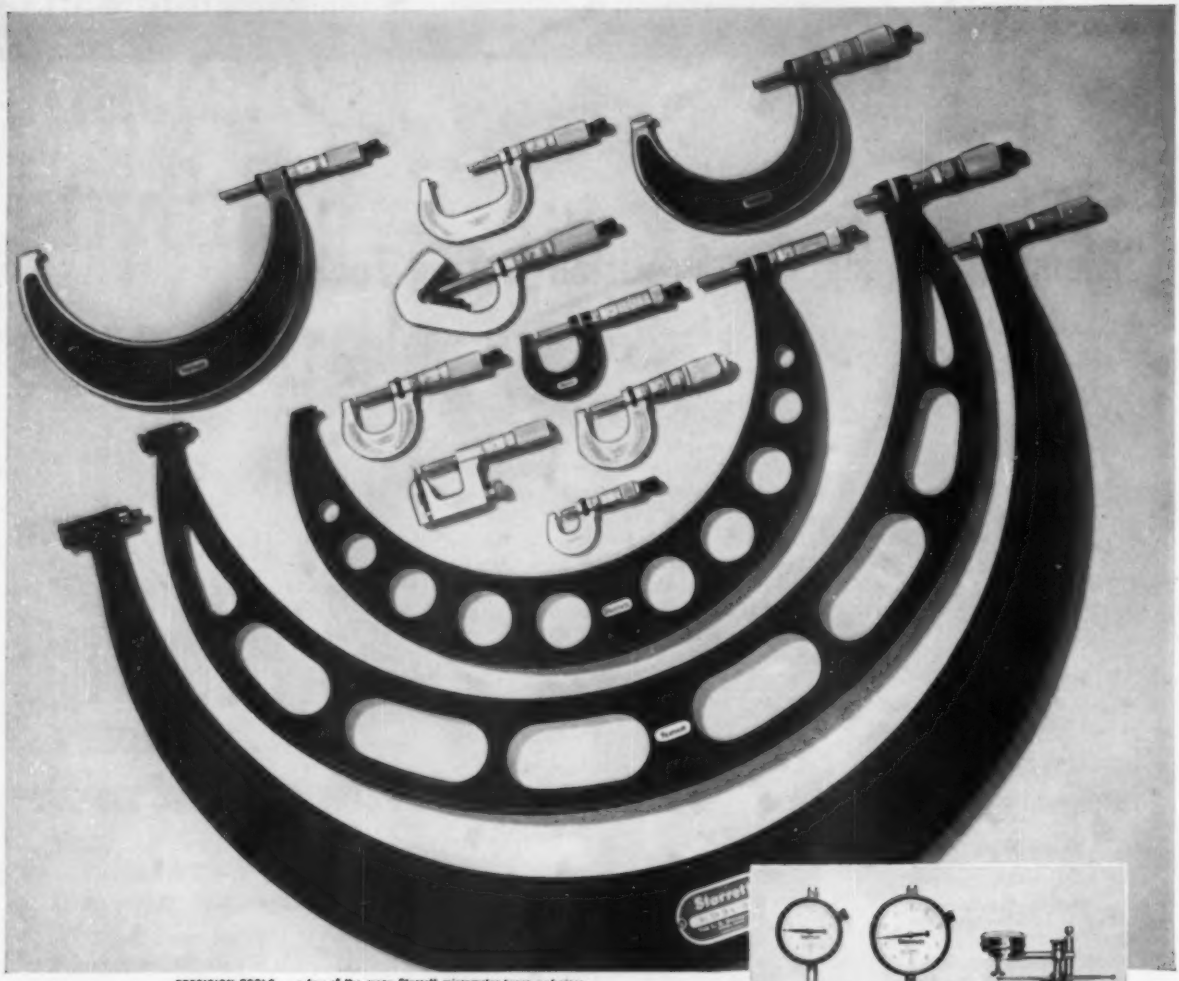
F Caplan, Kaiser Engineers, Oakland, Calif

In precision boring, clearance angles vary with bore diameter, work material, and the height of the tool above center. When a toolbit with side angles L is ground with bore-clearance-angle C, the side-clearance angle $F = \tan^{-1}$ (cos L times tan C). This normal relief or blending angle is the angle to which the tool is tilted during lapping. Reference: New American Machinist's Handbook, p 12-61.

Example: What is the side-clearance angle F if the tool has side angles $L = 10°$, and the bore clearance angle $C = 18°$.

Solution: Align $C = 18°$ with $L = 10°$ and read $F = 17° 45'$.


F = Side Clearance Angle, Deg.
C = Bore Clearance Angle, Deg.
L = Side Angle, Deg.
45
40
35
30
25
20
10
5
F = tan⁻¹ (cos L x tan C)
Angles F are produced when tool is set at angle C and any given angles L
F = bore clearance angle 10 deg.
C = 14 deg
When the tool is set at an angle in the quill, angle F becomes the bore clearance



PRECISION TOOLS — a few of the many Starrett micrometer types and sizes.

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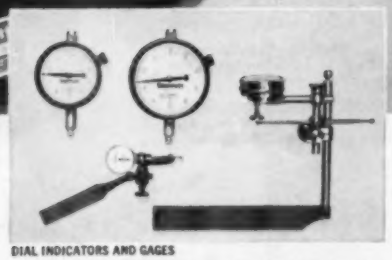
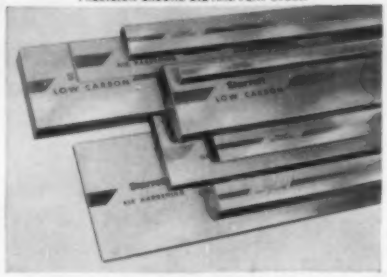


DIAL INDICATORS AND GAGES

HACKSAWS, HOLE SAWS, BAND SAWS, BAND KNIVES

PRECISION GROUND DIE AND FLAT STOCK



Talking Shop

Hear! Hear!

IN ST PAUL, Minnesota, a laborer was fired because he was 90 minutes late getting to work. He said his car failed to start in sub-zero temperature. The State Employment Security Department's appeals court ruled that if there was "misconduct" it was on the part of the weather and not the worker.

Our experience is that *most* people in this record winter have made remarkable efforts to get to work and to try to keep things going. We have also observed trains that wouldn't run, cars that wouldn't start, and a lot of snow that wouldn't melt.

A record winter is a good test of the mettle of both men and machines. We hope the test is over. And we think more attention had better be given to cold-weather tests of equipment that will be used in such arctic places as Minnesota and New Jersey.

Money-back Guarantee

MORE THAN 150 tons of copper roofing installed 47 years ago on the Grand Central Terminal office building in New York City was removed to make way for the new Pan Am Building. Leo Gach of the Lehigh Salvage Corp reports that the scrap value of the copper was 19½ cents per pound. Back in 1913, the year of installation, the average price of sheet copper was 21 cents per pound. So the copper cost was just about $100 per year for 47 years of use.

Author Slighted

A PRACTICAL SHORT CUT appeared last fall in the article "Solve Brinell Hardness With Simplified Formula" (AM/MM — Nov 14 '60, p 127). Through a simple oversight, the author's name was left out. As the page was being pasted up the name fluttered to the floor, the phone rang, the editor was distracted, the name on the floor was overlooked.

For the record, the author was Donald H Cronquist, Santa Clara, Calif. We're sorry, Mr Cronquist. We liked your idea (we published it) and you deserved better of us.

"Wet" Car

BACK IN THE TWENTIES bootleggers used to drive rum-laden cars across ice-covered Lake St Clair from wet Windsor (Ontario) to thirsting Detroit. Occasionally though, due to treacherous currents in the ship channel, car and load would plunge through to the bottom.

One such derelict, a 1923 Hudson, was recently recovered. Continental Motors, who made its engine, is justifiably proud that all that was required to start it was a new spark plug, one new coil, and a wiring harness. Makes one wonder if they really do build 'em like they used to.

How To Make It Melt

SNOW-MELTING COILS embedded in pavement are sure to get a boost from this record winter. A recent installation is the entrance drive to College Hospital in Brooklyn. More than 1200 feet of 1¼-in. harddrawn Type L copper tube was used.

The tube was received at the site in 20-foot lengths, bent into a serpentine shape by packing it with sand (to serve as a mandrel) and annealing the bend areas. One end of each tube was expanded so the sections could be "stovepiped" together.

When the snow starts to fall a standard glycol and water solution at about 150 F is pumped through the tubes. This solution is heated by the hospital boiler through a heat exchanger

There are a few other requirements: building felt around the tubing at expansion joints in the concrete, valves at low points for bleeding, vents at high points to prevent trapped air, and an expansion tank.

We're indebted to the Copper and Brass Research Assn for the timely description of this recent example of the best substitute for a snow shovel yet found.

Assembly Glossary

SOME HARDY SOUL in Chrysler has compiled a dictionary of the special terms used on the assembly line. Many of them are common terms in any metalworking plant. Here are a few that were new to us:

Baby Bath—The well lining into which the convertible top folds.

Disneyland — Engineering section of assembly plant.

Glop—Glue to hold discs to sanding wheels for metal-finish.

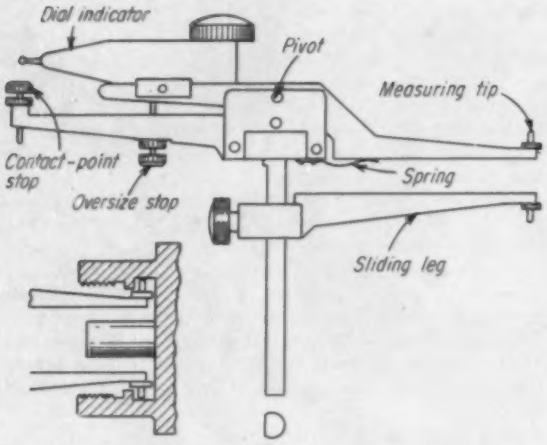
Gunk—A sealing material used on body seams.

Jungle—Spot welding area in body shop along assembly line.

Skinning—Assemble seat covers to backs and cushions. •

Practical Ideas

Indicator Caliper Straddles Obstructing Tube



This indicator caliper saved us the cost of buying a specialized caliper to measure O-ring grooves on a limited production item. An obstructing tube machined from the solid material made it impossible to insert standard calipers into the hole. So we improvised a caliper that could straddle the obstruction, by modifying a stock caliper and mounting a standard indicator on the pivot leg.

Here's how it works.

1) Move the sliding leg until the measuring tips are rough set to size (an ordinary scale reading is sufficient). Then lock the sliding leg by tightening the knurled lock screw down onto the flat side of the slide bar. (With the caliper gripped in a vice by its slide bar, and with a light leaf spring force against the pivot leg, your hands are free to set the caliper.)

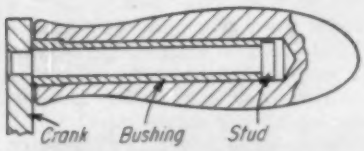
2) Set and lock a micrometer to exact dimension, and place it around the caliper measuring tips so that you get the exact dimension between caliper tips.

3) Bring the adjustable contact-high point stop into contact with the indicator point to get a zero reading on the indicator dial. Then lock the adjustable stop.

4) Bring the adjustable oversize stop into contact with the pivot leg, and remove the micrometer. Then back-off the oversize stop until the indicator dial reads 0.005 or 0.010 in., lock it there. This will be quite helpful when measuring in the blind.

5) The caliper is now set. Simply compress the measuring tips and insert them into the work. Then gently let the leaf spring open the pivot leg, and read the indicator dial.

Walter Shell, Brooklyn, NY



Handle Has no Sharp Edges

This free-spinning handle can be used for fixtures or to replace broken machine tool handles. It has no external end fittings that will snag hands or clothing, because it spins on an internal bushing (of brass or bronze) and stud (steel). The handle itself may be made of metal, fiber or wood.

To assemble the parts, first make a bushing with a raised, straight-knurled gripping surface at one end. Slip fit the bushing over a stud that is slightly longer than the bushing, and rivet the stud to the crank.

Then drill and ream a blind hole into the handle, making sure that the hole is deep enough to keep the stud from hitting bottom. Counterbore this hole so it will slip fit over the knurled gripping surface of the bushing. By counterboring you will also create a shoulder that prevents the handle from binding on the crank.

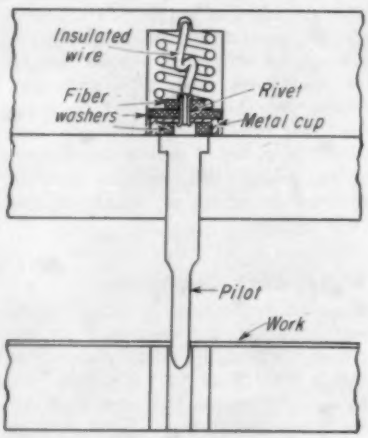
Now slip the handle over the bushing and it will snug up tightly over the straight knurl.

M W Loftus, Chicago, Ill

Misfeed Detector Stops Press

Here is a simple but reliable misfeed detector for progressive dies. In effect, it is a pushbutton (normally closed) which is activated by a pilot striking the top of the material if misfed. In addition to being simple and inexpensive to make, the detector can even be installed on existing dies; it requires little space, and can be made to operate on very small pilot movement.

The contact unit is made up of three fiber washers and a metal cup, the two top washers and the cup being joined by a hollow rivet. Of the two washers, the smallest locates the spring and the other insulates the spring from the cup. The washer inside the cup provide a non-conductive surface against which the pilot pushes to break the circuit between the cup and the punch plate in a misfeed. To insure the cup contacting the punch plate, the washer should be a few thousandths thinner than the depth of the cup.



Connection from the cup to any device that will stop the press is made through a stranded wire or a pig-tail lead soldered into the hollow rivet. A small hole, drilled horizontally through the die shoe and into the center of the spring recess, channels the wire to the back of the die. Good, flexible insulation must cover the wire from the point where it's soldered to the rivet until it leaves the die.

Emil Loeffel, tool engineer, Metalcraft Mfg Corp, New York, NY

Shaper Sub-Base Tilts Work up to 10, Requires no Weldments

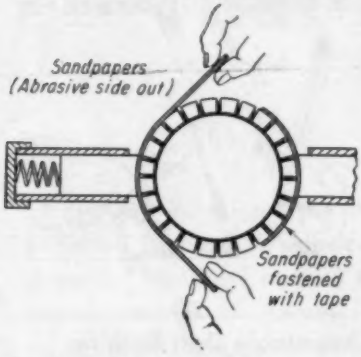
Instead of trading-in for a new shaper with a universal base, we modified our rigid-shaper vise with a tilting sub-base. Because the subbase tilts 10° up or down and the vise rotates, long cuts can be made to different angles by gripping the work across the short side.

Plates of the sub-base, made of cold-rolled steel, are bolted together with socket cap screws. This eliminates welding and any subsequent warpage, as well as the unavoidable machining of raised beads.

Slots for the side plates are both radiused one from the other, so that the bolts will not bind when the base is raised at either end. And, of course, the slots must be in the same position on both sides of the plates. With the side plates parallel to each other, at a clearance of 0.003 in., and squared to the base plate, the subbase assembly will fit snugly without binding.

A central jack screw could have been used to maintain angular position for heavy cuts, but we found it unnecessary. If steeper angles are required, you merely widen the side plates and lengthen the slots.

H Landauer, Tampa, Fla



Fitted Carbon Brushes Give Better Service

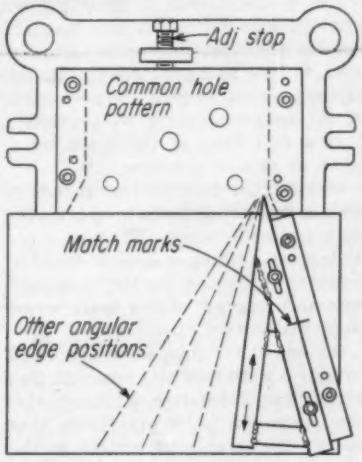
A common mistake in replacing carbon brushes in an electric motor is to install them, square end and all, and let it go at that. The result is that only the center of the brushes contact the commutator and, if the motor is allowed to run this way, sparking will occur to roughen the commutator.

Obviously then, to avoid damage and to attain maximum performance, the brushes should be fitted as closely as possible to the radius of the commutator. There are a number of ways to do this—two of which are illustrated.

The first, at left, is to insert the brush and allow it to rest on a strip of fine-grit sandpaper while backed up by its spring and plug. The sandpaper is then pulled forth and back until the brush is shaped to assume full contact on the commutator. If however, there isn't room to pull a paper, a strip can be fastened with cellulose tape and the commutator rocked from right to left and back again to obtain the concave radius.

Because by these two methods the brushes are fitted in the position they will eventually operate, more accurate fits are assured. But if neither can be applied, some means should be devised to get as perfect a fit as possible. Aids to this end may be a sandpaper mandrel of the commutator diameter and chucked in a drillpress, or merely a half-round file.

Nelson Hall, Detroit, Mich



Extension Expands Die Capacity

With the extension table shown, parts having eleven different reference edges are punched with a common hole pattern. The parts are of ½-in. hot rolled plate later to be bent in a press brake and installed in a heavy fabrication. Weight alone makes some sort of support inoperative and the addition of a straight edge makes it easy to pierce one batch of parts.

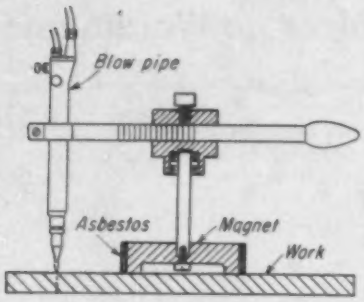
The ten other sets are located with the aid of wedges, placed against the straight edge and secured to the extension table. In all cases, an adjustable-depth stop controls the depth.

The extension is a weldment of two plates (a large one for the top and a narrow one for bolting to the die) and a pair of gussets. Its top face is located on the same plane with the face of the die block. Screws and dowels locate the straight edge at 15° off straight-line feed as required by the largest pieces.

The wedges are made from flat-bar stock into weldments of the angles needed, after which a light cut is taken on one edge to insure proper angle. Two screws secure them to the table through elongated holes so they can be adjusted and match marked for future use.

Gerald Millerwise, Sebewaing, Mich

Practical Ideas



Magnetic Base Speeds Disk Cutting with Torch

Here's a circular cutter that will firmly hold the center of any disk to be cut from steel plate. It doesn't require the center-punch mark usually necessary (and sometimes not permissible) with customary rigs. Merely place it over the center, and it's ready for use.

The model shown in the sketch employs a round permanent magnet, but an electromagnet may also be used, as long as it provides full radial support. In either case, the periphery of the magnet should be protected from direct heat of the torch by a layer or two of asbestos.

Making the rest of the cutter is simple, requiring easy-to-get materials and little work. The non-magnetic post (either stainless steel or brass) is inserted in the magnetic base and secured with a brass screw from the bottom.

On top of the post mounts a head equipped with two ball bearings that permit radial rotation. Through this head passes a horizontal beam that carries the torch. Adjustable to the radius desired, according to graduations, this beam is locked with a thumb screw. The graduations are established once the torch has been mounted and tried out. A standard split-clamp arrangement on the end of the beam holds a straight-line cutting torch vertically.

András Gábor, Budapest, Hungary

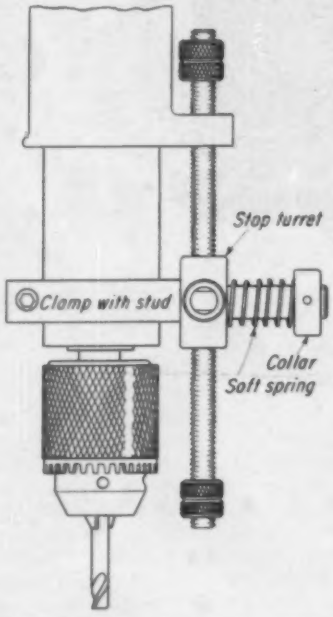
Turret-Depth Stop Speeds Drillpress Operations

Drilling holes of the same diameter to four different, accurate depths is an easy matter with the setup shown. What makes it easy is the inclusion of a four-turret depth stop which is indexed as required by the work layout. Here again, simplification can improve production speed by use of a color-code system.

For instance, when a drill jig is used in drilling a number of components, rings in four different colors are painted around the drill bushings. The adjusting nuts on the stop screws are then adjusted and locked at the depth required and painted the color corresponding to that on the drill jig. Thus, guesswork is abolished as a glance at the stop nuts tells the operator what holes to drill.

In many cases, the present quill clamp may be used—requiring only the removal of the old depth stop and screw holding it. At other times, a new clamp with an extended stud is made to carry the turret. A piece of round stock is bored to a running fit on the stud and faced on both ends. This serves as the hub for the turret and is drilled and tapped on the OD to take the four stop screws. Sometimes it may be necessary to mill flats on each side of the screws to make them fit the U-shaped opening in the quill housing. The turret is held in alignment on the stud with a soft spring and a collar.

H Koslow, Bronx, NY



R Dulek
Racine, Wis
Won $25 for his idea

Adjustable Drill Bushing Aids Gun Drilling
in the Dec 12, 1960 issue

AN EXTRA $25 will be paid for the best Practical Idea in each issue of *American Machinist/Metalworking Manufacturing*. Selection of the winning idea is made by a group of our readers.

PAYMENT—in addition to regular rate for item published—will be made as soon as tabulations are completed. The winner or winners—in case of a tie when duplicate prizes will be awarded—will also be announced in these pages.

JUDGES . . . are a group of *American Machinist/Metalworking Manufacturing* readers who select articles they prefer in a particular issue. This group changes entirely with each issue and represents a true cross-section of our readers. Their decision is accepted by the editors, without reservations or bias, as final in each case.

REQUIREMENTS—All items appearing in the Practical Ideas pages are eligible. They must be submitted by the originator on an exclusive basis. Do not worry about your shortcomings as an author, draftsman, or photographer—every item will be edited in accordance with *American Machinist/Metalworking Manufacturing* standards. Readers will judge only the finished product—in terms of its usefulness to them.

WHO MAY ENTER—Anyone may enter except employees of McGraw-Hill Publishing Co. Inc., and those of its advertising agencies or departments. Suggest to your employees that they submit ideas.

HOW TO ENTER—Send all entries to: "Practical Ideas Editor" *American Machinist/Metalworking Manufacturing*, 330 West 42nd Street, New York 36, NY.

By our method of reporting unemployment...

We're Giving The United States A Black Eye That Is Not Deserved

The way in which our unemployment is reported is giving the United States an undeserved black eye around the world. The broad concept of unemployment we use exaggerates the amount of unemployment in the United States as compared to most other countries. Our reporting system also falls short of presenting a balanced picture by concentrating on people who are idle, while neglecting jobs that are idle because people cannot be found to fill them. This editorial explains these defects and suggests improvements.

The *Monthly Bulletin of Statistics*, issued by the Statistical Office of the United Nations, has become a standard reference for international comparisons of economic performance, including employment and unemployment. Here, from the November, 1960 issue, is part of a table giving comparative figures on the rate of unemployment for the United States and a group of European countries:

	UNEMPLOYMENT RATE	
	Annual Average 1959	Jan.-June Average 1960
West Germany	2.4%	1.0%
Netherlands	1.8	1.4
Sweden	2.0	1.8
United Kingdom	2.3	1.9
United States	5.5	6.1

A Distorted Picture

If taken at face value the table clearly says that the United States is doing far worse in providing jobs for its citizens than the other countries whose unemployment records are listed.

But the figures are deceptive. They are made so, in part, by our government's use of a much broader concept of what constitutes unemployment than is used by most other countries.

Sweden provides a clear case in point. The table indicates that during 1959 Sweden had an unemployment rate of 2.0%, while the rate in the

United States was 5.5%. But a report from Sweden, published in the U.S. Department of Labor's *Labor Developments Abroad*, indicates that if they had used the same methods of calculating unemployment as we, the reported jobless rate in Sweden would have almost doubled. Thus a large portion of the gap between the unemployment rate in the United States and the unemployment rate in Sweden would have been eliminated.

Graduation To Unemployment

In general, countries listed in the table use registrations at public employment agencies as the basis for calculating their unemployment. Our Department of Labor, in making its sampling of unemployment, includes unregistered young people who are waiting for jobs or training opportunities as well as housewives who are looking for jobs in a general sort of way but who have not registered anywhere in search of them.

It used to be that graduation from college was regarded as a day for great celebration and rejoicing. But, because of the way the Labor Department does its counting of unemployment, it is now a day of sorrow. For unless our young people immediately rush off to jobs, they graduate into unemployment and swell our jobless figures.

While our government very expansively counts all the unemployed, there is no offsetting report on the number of jobs that are unfilled because no one qualified can be found to fill them. Currently there are many jobs in this category, and it is to be expected that there will be more as the technological revolution picks up momentum.

A properly balanced report on unemployment would include a record both of people who are idle, as conceived on some standard international basis, and jobs that are idle. A combination of the two sets of data would provide a much better indication of the economic health of a nation than unemployment alone.

The United Kingdom regularly collects figures on unfilled jobs as well as the number of unemployed. Thus it is not an impossible task to collect information on idle jobs. **For a fast moving economy, such as ours, the collection of statistics on unfilled jobs presents special difficulties. But this information is so important that Congress should see that it is added to our employment and unemployment records.**

A National Disservice

There is not the slightest inclination here to minimize the amount of unemployment in the United States at any time, or the crucial importance of doing everything possible to keep it at rock bottom. If the reporting of unemployment were simply for domestic consumption, it would be possible to make an appealing case for using a very broad conception of it. This is one way of underlining the importance of the problem.

But when, as is the case, international comparisons of unemployment are treated as key gauges of the effectiveness of different economies, we do ourselves an important national disservice by using an exceptionally commodious concept of unemployment. American travelers abroad can testify that they are continuously being called upon to explain why the United States does such a relatively poor job in providing employment for its people. This is an unwise and unfair burden to impose upon the nation. **We make enough mistakes of economic commission and omission without issuing reports that distort our economic performance to our own discredit abroad.**

This message was prepared by my staff associates as part of our company-wide effort to report on major new developments in American business and industry. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or part of the text.

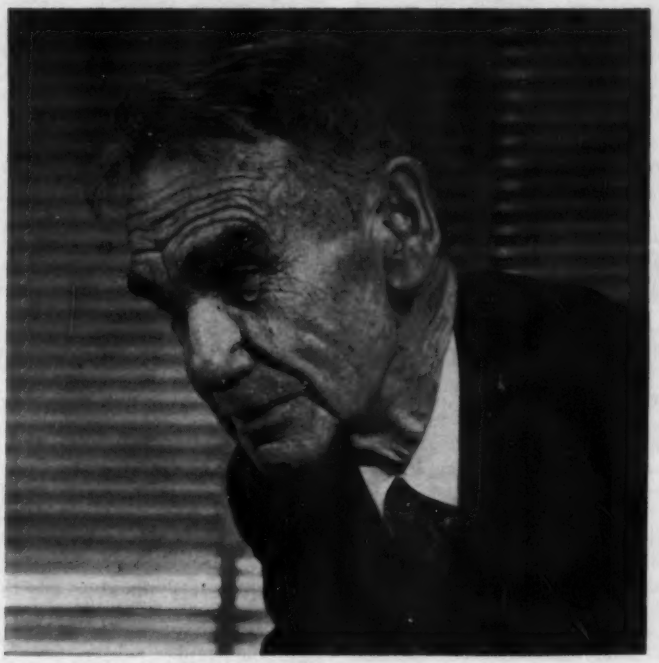
Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY

Edward W Miller

Engineer, inventor, elder statesman of industry, philosopher, friend of the great and near-great—a rare combination of words to fit a rare man. At 80 he is as rugged as the Vermont hills through which he daily drives his Jeep to his job as president of Fellows Gear Shaper Co, come rain, snow or what-have-you. Meet "Ted" Miller, one of Vermont's best-known and best-loved citizens . . .



The sage of Black River

"There is a zest in the air, an ineffable tang, the very essence of Vermont distilled upwards through hundreds of feet of spruce-scented atmosphere. And there the jaded body feels the fire of life return and the spirit of youth comes back to make one whole again."

One need look no further for the truth of these words than the man who wrote them. At 80, Edward Whitney Miller gets up at six, summer or winter, piles into his Jeep to drive through the hills to nearby Springfield, where he puts in a more-than-full day as president of Fellows Gear Shaper Co.

Apprentice to president

For more than 60 years, Miller has reported to work at Fellows—first as an apprentice in 1898 (he was Fellows' 18th employee), then as a journeyman machinist, and later as a draftsman, chief engineer (1915), general manager (1939), and since 1948 as president.

In those years, 63 to be exact, Miller has taken out nearly 100 patents in the machine tool field. "Don't recall the exact number, somewhere in the 90s, though."

He is extremely grateful to the fates which brought him from his native Torrington, Conn, (as they did E R Fellows and Governor James Hartness) to Springfield, the small Vermont city that has become world renowned for its machine tools.

Today, Miller is the elder statesman of the town's machine tool industry. And he and his friend and contemporary, ex-U S Senator Ralph Flanders, himself a onetime apprentice who became head of Springfield's Jones & Lamson, are among the town's leading citizens.

Gifted with a razor-sharp mind, tempered by a twinkling sense of humor, Ted Miller is a genuinely friendly man whose courtesy is a byword. A visitor from the *Wall Street Journal* once reported that when Miller's Jeep and a worker's Chevy met on the narrow bridge in front of Fellows, it was Miller who backed up to allow the other car to pass.

He has never forgotten that he began as an apprentice, and his first love is still the shop. From the youngest apprentice to the oldest of Fellows' master craftsmen, everyone gets a word or two of advice and encouragement from "Mr Ted" in his daily round of the shop.

The good neighbor

Over the years, he has made a deep impression upon the people of Springfield, too. In a town where virtually everyone is somehow connected with machine tools, Elder Citizen Miller's pride in the community is legendary, as is its pride in him. To walk down Springfield's main street with Miller is to stop every half-dozen-or-so feet for a chat with townspeople, executives and workers from J & L, Fellows and Bryant Chucking Grinder, and with the shopkeepers who come out to greet him.

His love for Vermont and its peo-

ple is more than reciprocated. Miller numbers among his intimate friends Judge Learned Hand, illustrator Maxfield Parrish, Arctic explorer Vilhjalmur Stefansson, Vermont's Governor and Senators, and famed World War II General Ernest N Harmon, now president of Norwich College.

The Squire of L'Habitat

His log cabin retreat, L'Habitat, in the hills outside Springfield, has become a sort of rural salon where these and others of New England's famous and near-famous foregather, in Miller's words, "Laughing, philosophizing, thoughtfully discussing world affairs, and best of all, getting acquainted."

Miller's own philosophy, incidentally, is quite a cut above the crackerbarrel. But then he seems to have more than his share of talent at anything he turns his hand to—a trait which is inherited by his son Spencer, who is president of the Maine Central Railroad. Daughter Marilyn is married to the assistant publisher of the Toledo *Blade*, and Adrianne, who lives in Springfield, is the wife of Fellows' Drill Department superintendent.

His other daughter, who is married to *Life* senior editor Sam Welles, inherits her father's way with words, once wrote a senior thesis at Wellesley which was later published word for word as "Joe Louis—American" and widely circulated to troops overseas in World War II. She still keeps her hand in, although she is the mother of three, as sports columnist for the *Christian Science Monitor* under her maiden name, Margie Miller.

Miller's Hall of Fame

"But if there is virtue in heritage," Miller smiles, "Let's remember that their mother, Grace Spencer Miller, had something to do with it, too."

"I have been privileged to know some of the really great men of our industry," Miller reminisces. "First of all, there was my employer and brother-in-law, E R Fellows, a store clerk and window dresser brought here by James Hartness knowing nothing at all about machine tools. But he was an authentic genius, made contributions to the industry equalled only by those of James Hartness, James Gleason, Charles H Norton.

"In my opinion these four men were the foundation upon which the U S machine tool business was built."

Miller is a fitting successor to these men. This onetime apprentice holds to his credit more patents than he can readily remember. Among them: a thread generator, a gear shaper that can cut worms, devices to side-trim gears, a planetary gear shaper, and a rotary gear shaper.

But even the ingenious, hardworking Yankees of Springfield have had to call upon outside help once in a while, although not quite in the way one would suppose, but let Ted Miller, no mean raconteur, tell it:

"Back in 1934, Caterpillar Tractor put through a rush order for what was then to be the world's biggest gear shaper. Ed Fellows and I got a little overenthusiastic, promised to get one to them in six months. We designed the machine all right, but as the March 1 deadline drew near we were 'way behind schedule—just couldn't get the bugs ironed out of the backing-off mechanism.

"To top it all off, a flu epidemic hit town along about that time, leaving only a half dozen or so of us to get the job out. We finally had the machine ready on March 15. But how to move it?

"We've got a 140-foot-long bridge over the Black River in front of our plant, and nothing gets into town unless it's over that bridge, which just wasn't built to support such a heavy machine.

"Our millwright went to work and shored up the bridge with heavy timbers. Then we found we didn't have a truck that could carry the machine. So we built a big skid. Next problem: how to move the skid?

"I tell you, I didn't get a wink of sleep that night. Along about 3 am, I started praying. At 6 am I looked out my window—the ground was covered with a good half inch of ice. We quick put a big truck ahead and a little truck behind that skid, and do you know, we slid that big machine for three-quarters of a mile right down to the railroad station!

"To cap it all, the sun came out and melted that ice just as we finished the job. It was the Almighty who helped us out on that one."

While Miller loves to reminisce about the things he has done and the people he has known, he prefers to look forward to new goals, rather than back upon his accomplishments.

This has been proved time and again the last few years, when Fellows Gear Shaper, under Miller's leadership, branched out into new fields as a bulwark against adverse times in the machine tool industry.

The company has, for example, in recent years gone into the twist drill business with no small success, has contracted to build and sell Pfauter (German) and Reishauer (Swiss) machines in this country and elsewhere, and manufactures a highly successful line of plastic injection molding machines.

The forward look

Ted Miller, they'll tell you up in Vermont, is more than a "nuts and bolts man," is in other words interested in the future of his community and state. A few years ago, for example, he gave his spacious home atop Springfield's Elm Hill to the town for an Art Center, where young people are taught not only to appreciate great works of art but are themselves taught painting and sculpture.

Miller's concern for the future goes even deeper. He has been in the forefront of many campaigns to conserve the waters, the woods, and the wildlife of Vermont for generations to come.

It has been a full life for Ted Miller. Looking back on his threescore years in the machine tool industry, Miller sums it all up in a sentence. "My job," he says, "has been great fun." •

Cutting Tool Manufacturers Association has elected **W R McClure** of **Eclipse Counterbore Co,** Ferndale, Mich, president of the Association. **Marlin R Hemphill, Allegheny Ludlum Steel Corp,** Ferndale, has been elected vice president.

US Industries Inc has appointed **John D Goodell** president and general manager of USI Robodyne Division, Silver Springs, Md. He was previously director of engineering.

Minneapolis-Honeywell Regulator Co has named **J M Sterling** to the new post of factory manager of the Electronic Data Processing Division. He will be responsible for the division's production operations at the Brighton and Lowell, Mass, facilities which produce the Honeywell 800 and 400 systems.

Racine Hydraulics & Machinery Inc, Racine, Wis, has appointed **Clare Hellenberg** manager of its Mobile Hydraulic Division. He will continue as chief engineer.

Gen Phillips W Smith, president of **Jack & Heintz,** Cleveland, a division of Siegler Corp, has been named a vice president of Siegler. •

Eaton Manufacturing Co, Richmond, Ind, has promoted **Robert C Jacobs** from assistant general manager of the Automotive Gear Division to general manager to succeed **G Willard Frame** who has retired

National Twist Drill & Tool Co, Rochester, Mich, has elected **William E Atchley** vice president, sales. He moves up from the post of sales manager. **Fred D Lamb Jr** replaces Mr Atchley

Yale & Towne Manufacturing Co, Philadelphia, has named **Charles S Beshore** manufacturing manager of Yale Materials Handling Division. He was previously assistant general manager of Yale's Automatic Transportation Co Division in Chicago

Yoder Co, Cleveland manufacturer of roll forming machinery and slitting equipment, has appointed **Eugene L Mackey** vice president, engineering; **Elmer A Koenig,** vice president, sales; and **Theodore R Stroomer** sales manager. Mr Mackey was formerly director of engineering and Mr Koenig director of sales.

General Motors has appointed **Henry T Brian** manager of the Buick-Oldsmobile-Pontiac Assembly Division plant at Arlington, Texas. Formerly production manager of the BOP plant at Kansas City, Kans, he succeeds **Robert J Hammond** who has resigned.

Canadian Westinghouse Co Ltd has elected **John D Campbell** president and chief executive officer. He succeeds **George L Wilcox** who has been elected vice president and assistant to the president of **Westinghouse Electric Corp,** Pittsburgh.

Standard Screw Co has named **Paul A Mongerson** vice president and general manager of the **Chicago Screw Co Division** at Bellwood, Ill. **Michael J Perrin** has been appointed vice president and general manager of the **Hartford Machine Screw Co Division,** Hartford, Conn. **Theodore R Pleines** has been made vice president and general manager of **Western Automatic Machine Screw Co Division** at Elyria, Ohio.

Berkeley-Davis Co, Danville, Ill, producer of automatic fusion welding equipment, and a subsidiary of the McKay Machine Co, Youngstown, Ohio, has appointed **William J Fisher** sales manager.

Illinois Tool Works, Chicago, has named **Harold Byron Smith Jr** manager of the new product divisions. He was formerly general sales manager of the Fastex Division.

Machine Tool Sales Co, Dallas, Texas, has named **David F Robinson** president. He succeeds **Irving H Buck** who died Jan 15.

High Speed Hammer Co, Rochester, NY, has appointed **George W Texter** plant manager.

Allis-Chalmers Manufacturing Co has appointed **Ballard M McKinney** works manager of the Terre Haute, Ind, Works. He was formerly superintendent of manufacturing.

(Continued on p 156)

Machinery Associates Inc, machine tool distributor headquartered at Wynnewood, Pa, has appointed **K Thomas Wagner** sales manager. He was formerly sales engineer in the York, Pa, territory

Birdsboro Corp has named **Harold C Sproule** manager of its Hydraulic Division, Reading, Pa. Formerly assistant sales manager there, he succeeds the late **Paul C Collins**

F Jos Lamb Co, Detroit machine tool builder, has elected **John K Rye** president. Mr Rye joined the firm in 1951 as assistant general manager and has been VP-general manager.

Whirlpool

Combination washer-dryer, one of the newest of a famous family of home appliances.

Workless Washdays Start Here

It's a long step from washday back to the Experimental Shop of the WHIRLPOOL CORP., at St. Joseph, Mich. But back there you'll find a battery of South Bend 16″ Toolroom Lathes hard at work turning out parts for the prototypes of tomorrow's appliances. The adaptability of South Bends to every type of operation gets work done quicker . . . their accuracy makes it right the first time . . . and their dependability keeps them on the job with fewer interruptions. Why not find out *now* how they can make your lathe work more efficient? Prices of 16″ Toolroom Lathes start at only $3230—time payment plan available.

SOUTH BEND LATHE

SOUTH BEND LATHE, INC.
SOUTH BEND 22, IND.

Builders of Lathes • Milling Machines • Shapers • Drill Presses • Pedestal Grinders

Brightener for Zinc Plating May Be Added in Liquid Form

Zinc Brightener 25, which is a free-flowing liquid brightener for zinc plating baths, may be added directly to the baths without prior dilution. It is suitable for use in barrel, as well as hand, hoist, or automatic plating operations.

Other advantages claimed for the new brightener include: brilliant and crystal clear zinc deposits that exhibit uniform high luster and exceptional receptivity of the zinc deposit for bright and chromate dips; full, bright deposits on case-hardened or hot-rolled steels; packaged in 5-gal containers.

Although the composition of the plating bath may be varied within wide limits of concentration, it is recommended that 0.64 fl oz/gal (2 qt/100 gal) of the brightener be used with the following composition for optimum results at a 70 to 80 F plating temperature: zinc cyanide, sodium cyanide, and sodium hydroxide at 8, 516, and 1015 oz/gal (respectively) for barrel plating, and at 10.6, 5.0, and 15.0 oz/gal (respectively) for rack plating.

Metal & Thermit Corp, General Offices, Rahway, NJ

MORE DATA? Circle 101, inside back cover

Pre-Coated Steel Strip Promises Savings in Forming Operations

A new specialty strip steel product, Thomas Pre-Lubricated Strip, is said to offer cost and production savings in severe forming operations. The steel strip is produced by treating the metal with a solution of phosphate and animal fats. This provides a coating that acts as an anchor for a film of fatty lubricants and serves to separate the steel from the die or forming tool during forming.

The dual-purpose lubricant coating was specifically forming.

- Increase production, particularly in deep-draw applications.
- Prevent die marks.
- Reduce scrap.
- Permit lesser requirements for steel gauge and quality.
- Reduce die maintenance.
- Supply progressive die lubrication.
- Protect against indoor corrosion.

The fatty lubricant is said to have high lubricating properties, and neither the phosphate or fat coating is supposed to interfere with welding. The dual coating can only be applied to steel but it can be used on any type of steel finish. After forming, the fat coat can be removed by a hot alkaline bath and the phosphate coating by a weak acid bath.

The strip is available in coils up to 22-in wide, or cut lengths up to 24-in.

Pittsburgh Steel Co, Grant Building, Pittsburgh 30, Pa.

MORE DATA? Circle 102, inside back cover

Felt Pad for Machine Mounting Reduces Both Vibration, Creep

Perf-O-Grip Vibra-Mount, a perforated resilient wool felt mounting pad, is said to reduce transmitted machine vibration by as much as 85%; it also cuts down horizontal "creep."

The company claims that most machinery can be positioned and installed, without the need for lag bolts in the floor, by securing the new felt undermounting with its line of Vibra-Mount adhesives. Other advantages said to be gained by using Perf-O-Grip: machinery can be run at peak capacity without costly repair and down time, greater precision to close tolerances can be attained, employee morale and safety is improved through less nerve-wracking noise, and vibration damage to building structure is reduced.

The new mounting pad is available in general purpose densities—loads from 10 to 50-lbs per sq in.—and heavy duty densities—machine loads above 50-lbs per sq in.

American Felt Co, 2 Glenville Rd, Glenville, Conn

MORE DATA? Circle 103, inside back cover

Jumbo Zinc Blocks Designed To Cut Materials-Handling Costs

High purity and Prime Western grades of slab zinc are now available in 2,500-lb pigs. The king-sized slabs are designed to cut customer's material handling costs.

The pigs measure 36x28x16-in. and are designed with legs and wings for easier lift-truck handling. Tapered holes in the top of the slab facilitate crane hoisting.

The New Jersey Zinc Co, 160 Front St, New York 38, NY

MORE DATA? Circle 104, inside back cover

Nylon Rod is Electrical Grade

Zytel 31 rod, made of an "electrical grade of nylon," is said to have a lower moisture absorption rate, and to be more dimensionally stable than general purpose grades of nylon.

The rod, for use in the electronic, radio and other electrical fields, is available in diameters from ¼ to 3-in. in natural colors only.

A L Hyde Co, Grenloch, NJ

MORE DATA? Circle 105, inside back cover

Teflon Spheres Solve Flotation Problems

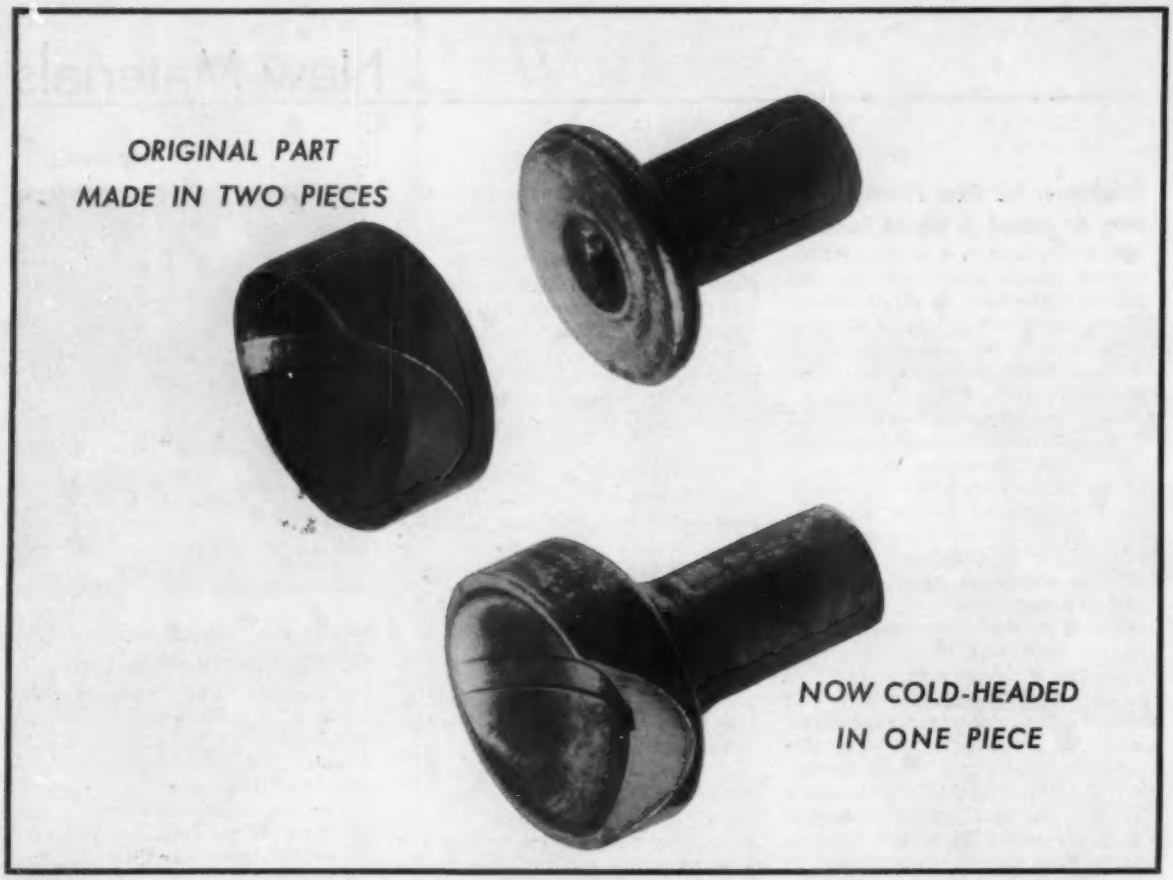
Thin, tough, hollow spheres of high density Teflon are said to solve flotation problems in highly corrosive fluids. Molded of virgin TFE fluorocarbon resins, the spheres are unaffected by all solvents and virtually all known chemicals at temperatures ranging from –350 to 500 F.

A high degree of flotation, near perfect roundness, and resiliency indicates application of the spheres as ball check valves for flow meters and flow valves or as float level indicators in tanks of highly corrosive fluids.

The non-adhesive, non-absorbing spheres are available in sizes from 20 to 100-mm dia.

Chemplast, Inc, 3 Central Ave, East Newark, NJ

MORE DATA? Circle 106, inside back cover



Cold-heading cuts costs—
replaces two parts with one!

The two-piece part, comprising a stud and a seat, has been replaced by a single part which is now cold-headed at considerable savings. It's used in the assembly of an automotive steering-rod relay system.

A special type of Bethlehem cold-heading wire was developed for this job. Costs are well under the previous method of manufacture. Cups have good surface finish and high strength.

This is a typical example of the small parts which are constantly under study by manufacturers searching for better materials, improved methods, and lower costs.

Look at these advantages of cold-heading

High-speed production . . . low scrap loss . . . economical stock . . . high strength . . . minimum of finishing operations.

Perhaps your product can be cold-headed

Heading-quality wire, custom-made for the job, has long been a Bethlehem specialty. Our metallurgical engineers will gladly work with you if you have a product that might be cold-headed. For any of your wire needs, call your nearby Bethlehem office, or write us at Bethlehem, Pa.

Steel
For strength
. . . economy
. . . versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Epoxy Paste Forms Adhesives With 4 Different Curing Agents

Epon Adhesive 901 is a solvent-free epoxy paste which can be cured with four different agents. The grey resin is said to have an extremely high viscosity and, when mixed with any of the four curing agents, it forms adhesives which are thixotropic even during cure at high temperatures.

The curing agents to be used with Epon Adhesive 901 are:

- Agent A—a red, very low viscosity liquid. When mixed with the paste, the resulting adhesive has a pot life of 2 hr at 75 F and a service temperature range up to 225 F. Recommended cure: 2 hr at 200 F.
- Agent B-1—a red liquid having a pot life of 50 min at 75 F and service temperature range up to 225 F. This adhesive can be cured at any convenient temp from 75 to 250 F.
- Agent B-2—a red liquid with a pot life of 30 min at 75 F and a cured service temp up to 225 F. When cured for 2 hr at 200 F, the adhesive gives bonds to aluminum of 3000 psi in tensile shears at –67F, 2650 psi at 220 F, and 950 psi at 260 F.
- Agent B-3—a dark liquid making an adhesive with a pot life of 6 hr at 75 F and a service temp up to 350 F. Suggested cure: 30 min at 240 F plus 90 min at 350 F. It meets requirements of MIL-A-8431 (US AF) Type I, Class B, heat-resistant structural adhesive for aluminum bonding.

The cured adhesives supply tensile strengths of up to 3800 psi.

Adhesives Dept, Shell Chemical Co, PO Box 831, Pittsburg, Calif

MORE DATA? Circle 94, inside back cover

Two Armco High-Strength Steels Come in Plates, Sheets, Strip

Two new columbium bearing high strength low alloy steels, No. 6 and No. 7, offer minmum yield points of 50,000 and 45,000 psi respectively. The new grades are available as plates, hot-rolled sheets, and hot-rolled strip.

Corrosion resistance of these grades is equivalent to mild, non-copper bearing steels; formability characteristics permit simple bending across the rolling direction, flanging and light forming operations of the type regularly performed on standard commercial quality sheet and plate.

No. 6 exhibits welding properties similar to a 0.20% carbon steel, while No. 7 has properties similar to a 0.10% carbon steel. Yield strengths will be certified if requested.

Hot-rolled products of both grades can be supplied in the pickled condition if desired. Maximum lengths for pickled sheets are 200 in. for sheets up to 60 in wide and 180 in. for sheets 60 to 72 in. wide.

Armco Steel Corp, Middletown, Ohio

MORE DATA? Circle 95, inside back cover

Homogenized Silver-Brazing Flux Features Unlimited Shelf Life

S-200 Brazaloy is a micro-ground, production silver-brazing flux for torch, furnace, or induction brazing on stainless, nickel alloys, copper, brass, bronze, steel, berrylium-copper, and all silver alloys. It is said to have unlimited shelf life

The homogenized flux indicates working temperatures by boiling at 212 F, dissolving metal oxides between 600 and 800 F, and by becoming transparent at 1100 F. Its active range is between 500 and 1800 F.

All-State Welding Alloys Co, Inc, 249-55 Ferris Ave, White Plains, NY

MORE DATA? Circle 96, inside back cover

Tantalum Powder Aids Capacitors

Designated SGP, a new tantalum powder is said to improve the fabrication and performance of electrolytic capacitors. The powder enables pellets to be pressed to lower green densities, lowering dissipation and increasing capacitance per gram. At the same time, the tantalum retains the electrical properties and chemical purity of the company's SGN powder.

National Research Corp, 70 Memorial Dr, Cambridge 42, Mass

MORE DATA? Circle 97, inside back cover

Cutting and Tapping Lubricant Sticks Well and Is Non-Drying

EEZ No. 2-15-T, a specially formulated tapping and cutting lubricant, is a semi-liquid material applied to the work by brush or tool immersion. Its use is said to assure greatly extended tool life, closer tolerances, and fine finishes, and it is especially effective in the extrusion of chips in blind hole tapping.

Because it is non-drying and sticks with the tool, the lubricant can remain on tools or finished work for long periods of time and then be easily wiped off.

The EEZ No. 2-15-T is non-toxic, has no offensive odor, and will not contaminate coolant or cutting oil when used on the same machine.

Leonard Smith, Inc, 2915 Independence Rd, Cleveland 13, Ohio

MORE DATA? Cicrle 98, inside back cover

New Cement is Fast Drying

An improved Red Line machine mounting cement is said to dry 25% faster than the company's previous types. Average drying time: 6 to 8-hr. The smooth-finish compound can be applied by brush or spatula.

Holding power of the cement is about 90-lbs per sq in. plus the weight of the machine, or roughly 15,000-lbs per sq ft. However, the company claims it can be easily softened with alcohol or carbon tet.

The cement is red for easy identification and is said to be resistant to oil, kerosene, water, cutting compounds and coolants.

Unisorb, Div of the Felters Co, 210 South St, Boston 11, Mass.

MORE DATA? Circle 99, inside back cover

Aluminum Alloys Have Nuclear Application

New Aluminum welding and brazing alloys, 718, 1100 and 4043, are now available in "nuclear grade" certification. This development is said to open atomic reactor and radio-chemical fabrication markets for welding alloy manufacturers.

The alloys have a low percentage content of elements which become dangerously radioactive when bombarded with neutrons (*eg*, lithium) or those that remain radioactive for long periods of time (*eg*, silicon).

Available in precision spooled wire and cut length rods, the new nuclear grade aluminum alloys are expected to be used extensively in reactor, tank, and pipeline fabrication.

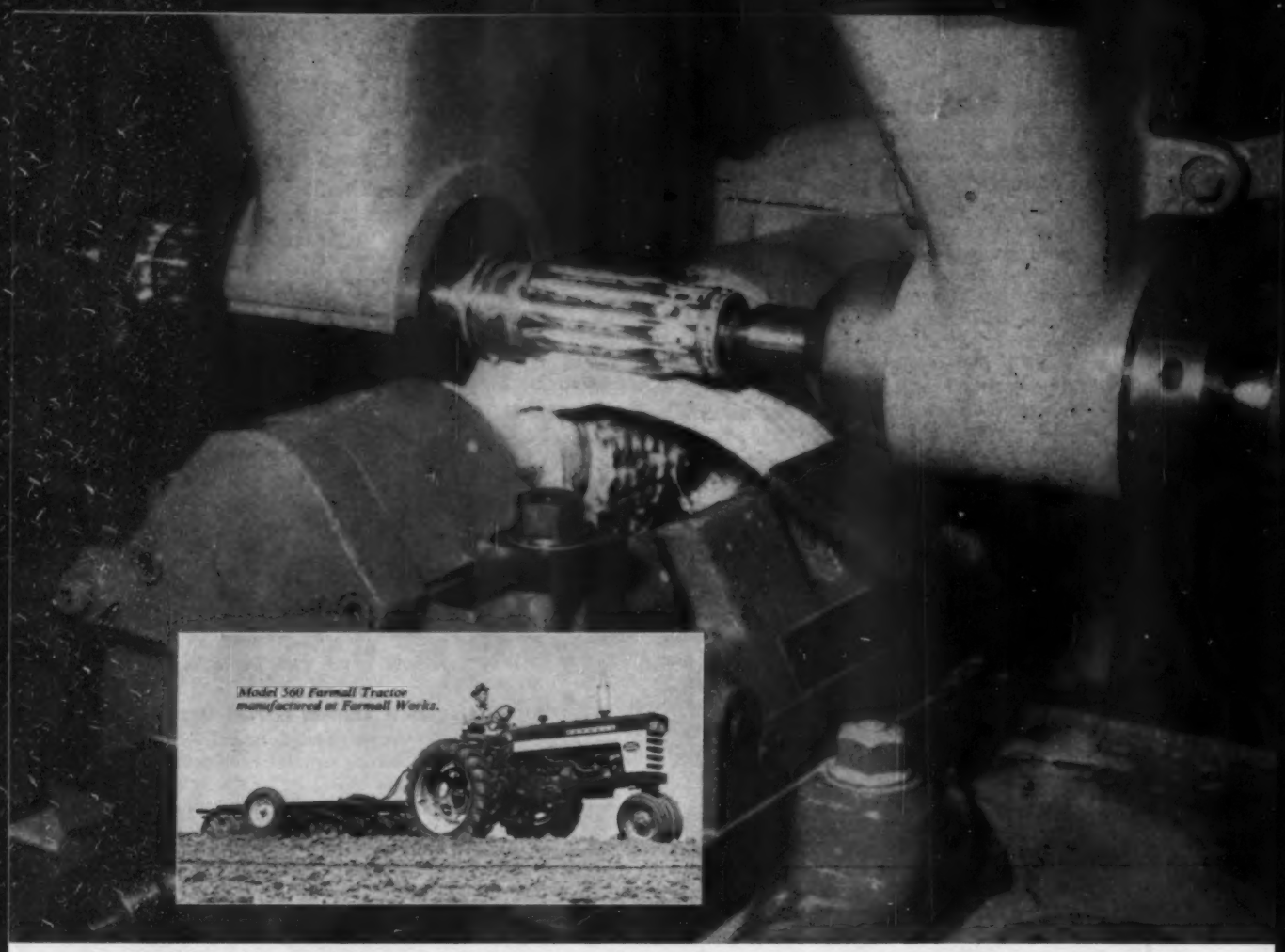
Maximum analyses of the company's three nuclear grade alloys are:

Type	*Al*	*Cu*	*Fe*	*Si*	*Mn*	*Mg*	*Zn*	*Ti*	*Be*	*Other*
718	Balance	.30%	.30%	11-13%	.15%	.01%	.20%	—	—	.15%*
1100	99% min	.20%	1.0%	= max	.05%	—	.10%	—	—	.15%*
4043	Balance	.10%	.80%	4.5-6%	.05%	.05%	.10%	.20%	.0008%	.15%*

* Includes maximum of .008% Li, .003% Cd, .001% B, and .001% Co.

All-State Welding Alloys Co, Inc, 249-55 Ferris Ave, White Plains, NY •

MORE DATA? Circle 100, inside back cover



Heavy flow of Kerns Soluble Cutting Fluid prolongs tool life while keeping part and hob exceptionally cool during gear hobbing operation on a Farmall tractor clutch shaft.

KERNS SOLUBLE CUTTING FLUID MEETS HIGH PRODUCTION STANDARDS AT IH FARMALL WORKS

Researched and developed by Kerns United, this specialized lubricant is used on a variety of operations at the Farmall Works of the International Harvester Company including reaming, drilling, tapping and hobbing . . . with guaranteed performance.

As machining operations and metals vary, so do lubricants. Know what can be accomplished by utilizing Kerns capabilities, experience and products formulated to meet your specific requirements. It's easy . . . see the results of a tailored lubricant in your plant at no cost by taking advantage of Kerns Memo Billing Trial Basis.

Manufacturers of Cutting, Grinding, Drawing, Forging, Phosphatizing, Cleaning, Wire Drawing and Spray Booth Compounds; Rolling Oils, Rust Preventives, Cling Oils and Specialized Greases.

Write for further details on Kerns MEMO BILLING TRIAL BASIS offer and/or technical data sheets on any of the above items.

World's largest Exclusive Manufacturer of Specialized Industrial Lubricants.

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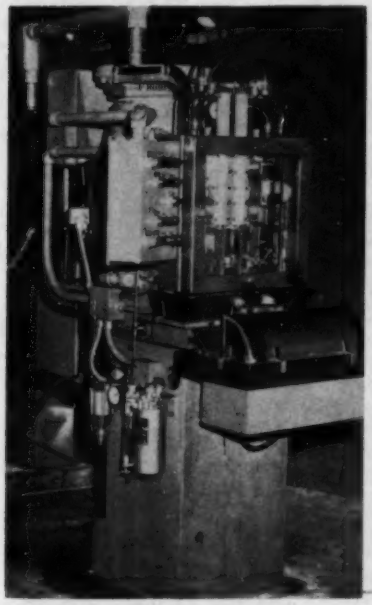
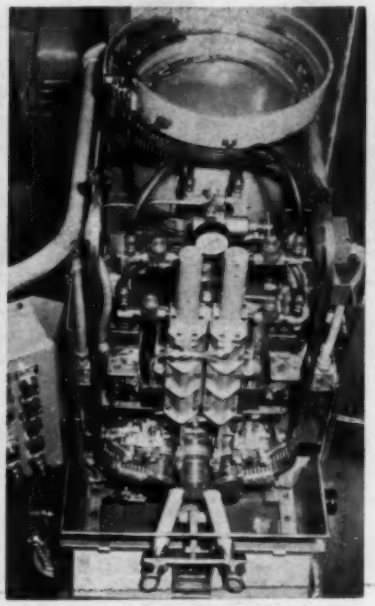
CIRCLE 216 READER SERVICE CARD





Gisholt Superfinishing Machine Gives High Production Rates for Small Parts

Masterline Model 84 Superfinisher is said to give a cost-cutting answer to the problem of finishing small parts at high production rates. Rates vary from 4 to 20 parts a min, depending on work size, finish desired, and type of material. Because the speedometer cable couplings (shown, being finished, on cover) are made of soft steel, they are run at a ten part rate to reduce the surface from 25 to a controlled finish of 10 micro-inches rms. Hardened bearing rollers would be produced at a somewhat slower rate, with the final finish of 2 to 3 micro-in. rms being produced automatically.

A vibrating hopper (top of right-hand photo) moves parts into feeder channels at both sides of the machine, where they are gravity fed to the load position by rotating work rolls. The backlog of parts at each side is controlled by an escapement that allows one part to move from each side onto work rolls.

As soon as the parts are on the work rolls, two quills carrying Superfinishing stones move down to contact the cylindrical OD surfaces. The parts rotate while the stones reciprocate under moderate pressure for a predetermined length of time.

After finishing is completed, the stones rise and air jets eject the parts into separate discharge tubes. They drop into a catch pan in front of the machine, which is filled with oil to prevent surface damage.

Automatic lubrication of the machine's working members, and mist lubrication for the stones assure minimum maintenance problems. The stoneholder quill head has both vertical and angular adjustment so that tapered parts can be handled.

Gisholt Machine Co, 1245 E Washington Ave, Madison, Wis

MORE DATA? Circle 51, inside back cover

Cutoff Saw Through-Cuts Carbon and Stainless Steels up to 16-in. Wide

Called Promacut Uni-11A, this new saw is said to cut all shapes of carbon and stainless steel, and many of the new alloys. The company has designed the saw to be equally versatile for random cutting jobs in fabricating shops or for high volume production operations.

Similar to a unit introduced about two years ago, the new model features many improvements:

- An open table surface provides a 27-in. clearance between the blade and column for through-cutting of long stock up to 16-in. wide.
- A simple adjustment of only one locking lever sets the spring-loaded, counterbalanced head to obtain the proper approach to work in a matter of seconds.
- A unique saw tooth shape produces a semi-milling action.
- Blade speed is so fast that heat is not absorbed, with the result being a cut that is virtually burr-free without drag or clamping. Coolants are not necessary.
- Pressure of sawing, alone, holds the stock in place.

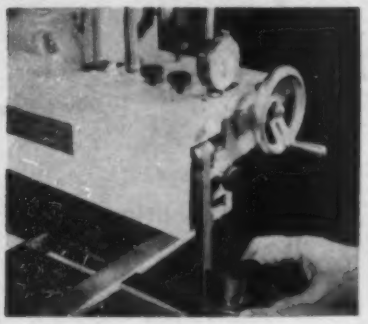
The basic cutting principle of the saw is dependent upon tooth shape, the angle of approach to the work, and the speed of rotation and high torque.

Cutting speeds range from 11-sec. for through-cut on a 12-in., 16.5-lb. I-beam down to 1-sec or less on a 2x2x¼-in. angle or 2x¼-in. flat bar. Up to 4,000 cuts can be made before the blade needs resharpening.

Other typical cutting times are: 12-in., 20.7 lb channel, 9 sec; 1-in. round bars, 3 sec; 4-in. diameters, ⅛-in. wall tubing, 2 seconds.

Production Machinery, Inc, 4941 West Belmont Ave, Chicago 41, Ill

MORE DATA? Circle 52, inside back cover



Precision Belt Grinder Eliminates Hand Finishing for Much Tool and Die Work

This precision belt grinder, which features a shoe that can be lowered into a die or moved along the edge of a punch, is said to cut the cost of tool finishing up to 90% over that of hand filing and stoning. The shoes are made in ¼, ½, and 1-in. sizes, and can also be furnished with curved surfaces.

Another feature of the machine is its knob-and-gage arrangement for setting a desired angle of belt to work. The gage is calibrated for accurate settings of ¼, ½, and ¾ degree; the shoe can be positioned to grind any desired taper up to 5°.

The manufacturer — Kar-Ry Co, Inc, of East Haven, Conn—supplies the grinder on a wheeled stand so that it can be moved right to the work; it may also be purchased, without the cabinet, for bench mounting. It operates from any 110 or 120-v outlet.

By simply placing a bar across the table, grinding from a templet is very easy with the use of a spacer between templet and work. As a matter of fact, several parts can be stacked up and ground at the same time from one templet.

The complete machine—with a ¼, ½, and 1-in. flat platten and a supply of 18 belts in various grades—sells for $1295. Replacement aluminum-oxide belts cost less than 50¢.

Dist by Industrial Machines & Services, Inc, P O Box 995, New Britain, Conn

MORE DATA? Circle 53, inside back cover

Electronic Instruments Measure Press Loads in Production Runs

Load Monitor (Model 112) is designed for continuous measurement of all press loads on a given press, responding instantly regardless of press speed. It registers loads from 0 to 140% of press capacity and consists of a control unit located near the press, plus two or four pickups mounted permanently on the press frame or tierods. In order to prevent overload repeats, it is equipped with a special tripping circuit which disengages the clutch when the preselected percentage of press capacity is reached.

Tonmeter Model 119 (illustrated) is a portable instrument designed to show the maximum load on a press during operating cycle as well as die setting. In operation, it is plugged into pickups mounted on the frames of the press or presses to be checked, responding instantly, regardless of press speed.

Niagara Machine & Tool Works, 683 Northland Ave, Buffalo 11, NY

MORE DATA? Circle 54, inside back cover

Automatic Vacuum Units Cooled By Forced Gas Circulation

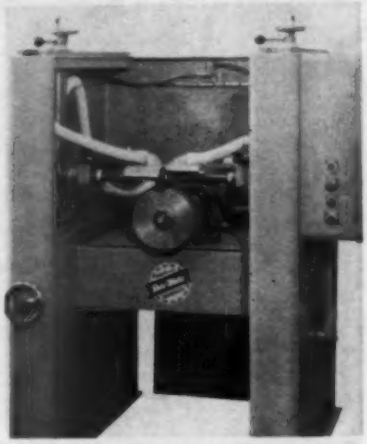
Gas cooling by an internal centrifugal fan is featured in the company's automatic vacuum heat treating units. The operator simply sets time and temperature controls to start the furnace through automatic cycle.

After the work is placed in the furnace, it is heated once the chamber has been pumped to a preset vacuum. At the end of the soak cycle, an inert gas is introduced into the chamber. A centrifugal fan forces the gas along a finned cold wall and up through the work load.

Gas is said to work through the load at optimum velocity with a minimum of turbulence. When the charge has been cooled to 300 F, an alarm sounds informing operator that the work can be unloaded.

Ipsen Industries, Inc., Rockford, Ill.

MORE DATA? Circle 55, inside back cover



Roto-Matic Deburrer Eliminates Filing and Use of Hand Wheels

This new Roto-Matic Deburring Machine uses two floating arms so that both ends of teeth can be deburred simultaneously and operation completed after one revolution. Because the machine eliminates filing and the use of hand wheels, it is said to save considerable time.

The spindle, which has a ¼-hp variable speed drive with electronic control, has speeds from 0.227 to 5.74 rpm. Grinding heads are run by air motors operating at 12,000 rpm. Grinding wheel diameter is 3 in. max; however, gears of larger or smaller pitch diameters can be deburred on special application.

The housings over the grinding wheels are the intake for the exhaust system and therefore eliminate the necessity for completely enclosing the machine. Hence, there is much freer movement in handling work pieces.

Davis and Thompson Co, 4460 N 124th St, Milwaukee 18, Wis

MORE DATA? Circle 56, inside back cover

Torque Wrench Offers Two Different Torque Limits

Twin-Torq tool which offers two different troque limits without need for dials or adjustment can make fast and positive inspection of torque tolerances of previous assemblies.

It is equipped with two opposing drive tangs; a red marker on the handle identifies the tang with the higher torque. For inspection of critical assemblies, the fastener must not move on the low torque limit to pass inspection but it must move when the high torque limit is applied. Capacities range from 5 in.-lb to 500 ft-lb; drive sizes are ¼ to ¾ in.

Jo-Line Tools, Inc, 8442 Otis St, South Gate, Calif

MORE DATA? Circle 57, inside back cover

Miniaturized Lighted Pushbutton Switch Smaller Than Cubic Inch

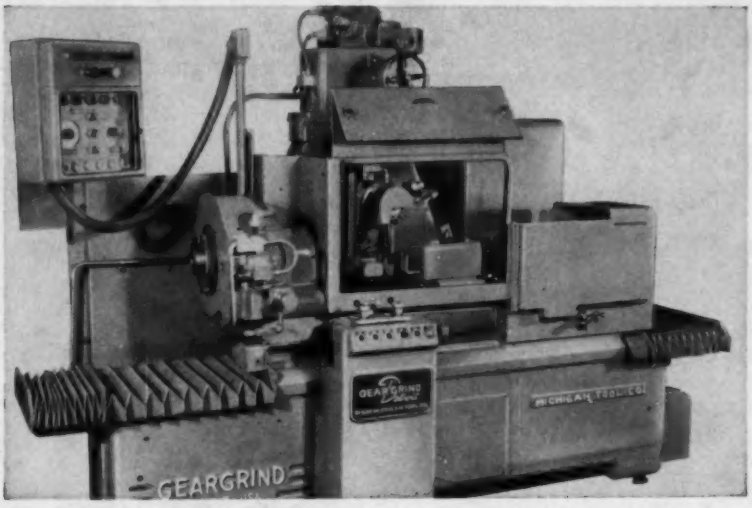
This new miniaturized lighted pushbutton switch—which measures 0.812 x 0.89 x 1.303 in.—has single or two-color indications, and each half of a divided display screen has its own light source. Therefore, since five colors are available for the display screens, a single switch can have any one of 15 color combinations.

Permanently assembled into a single mechanical unit, the pushbutton switch contains two single-pole, double-throw, sub-subminiature switch elements rated at 7 amp resistive and 25 amp maximum inrush at 24 v dc; 7 amp resistive and 15 amp inrush at 115/230 v ac.

A stock item, the switch lists at $16, with quantity discounts available.

Micro Switch Div, Minneapolis-Honeywell, Freeport, Ill

MORE DATA? Circle 58, inside back cover



Optical gear checker (above) sets angles to 0.001 degree without gage blocks. Accuracy repeats to 0.0001 in. New gear grinder (left) rough and finish-grinds gears up to 10-in. outside diameter

Michigan Tool Introduces Gear Grinder, Optical Checker

The latest additions to Michigan Tool's line of gear equipment are a Sine-Line lead checker, in which settings are made optically, and a machine which crown grinds the teeth of spherical gear type couplings. In addition, the grinder can also be used to grind spur gears and splines as well as ease-off near the end of spur teeth.

Angle settings on the optical checker are independent of the operator's touch and can be made within 0.001 degree without the use of gage blocks. Checking accuracy is repetitive within 0.0001 in. on these instruments which are used to check involute profile on spur or helical gears as well as tooth spacing.

Automatic grinding

In addition to ability to be operated in semiautomatic or manual cycle, the Model CGG-16 x 18 FA grinder can be preset for a completely automatic cycle of roughing, semi-finishing, and finish-grinding gears up to 10-in. OD. When finishing crown gears, the automatic cycle will:

- Grind each tooth to rough size in a pre-selected number of cuts, with down feed at each reversal of stroke;
- Index to next tooth and reset head;
- Feed wheel down and dress it after a selected number of teeth are rough ground;
- Semi-finish grind all teeth in successive passes;
- Feed wheel down and dress it after all teeth are semi-finish ground;
- Finish grind all teeth in successive passes, and stop.

Grinding wheels from 6 down to 3-in. dia can be used. Because of the oscillating drive used when crown grinding, the crown radius is not affected by diameter of the grinding wheel. A crown radius up to 12 in. can be ground on gears of 10 in. dia.

Coolant, which is introduced through the wheel, comes from a built-in coolant system. The wheel is mounted on a precision, preloaded, ball-bearing motorized spindle rated at 2 hp at 3600 rpm.

Checker has probe

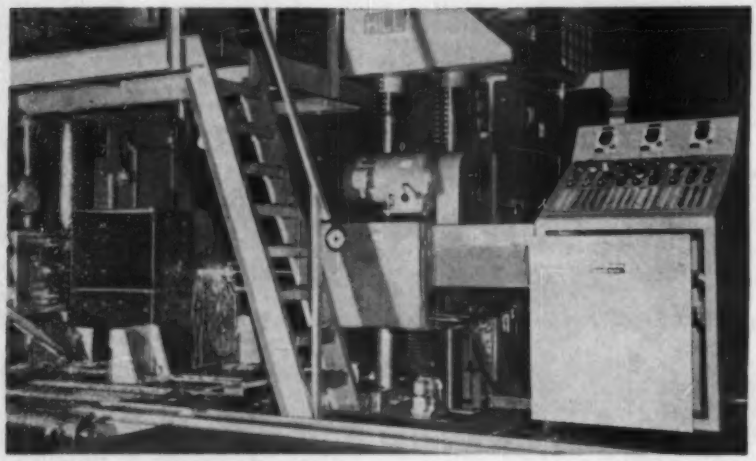
When a gear is to be checked on the Sine-Line checker, it is mounted between centers and an indicator sensing probe is brought into contact with the involute contour. The indicator is set—through use of the optical system—so its tip travels in a path tangent to the base circle.

The Model 1124 instruments will check gears with maximum diameters to 12 in., and have normal maximum center distance of 14 in. A Model 1124-C checker will inspect gears with max dia of 20 in., and has normal max center distance of 24 in. Special column heights to further separate the centers are available.

Design of the optical setting system is such that it can be applied to Model 1124 and 1124-C already in use, and system is on the market.

Michigan Tool Co., 7171 E McNichols Rd, Detroit 12, Mich

MORE DATA? Circle 59, inside back cover



Hill N/C Drilling Machine Cuts Cost Of Producing Holes in Structural Steel

In its first application at the R C Mahon Structural Div in Detroit (see *AM/MM*—Feb 6 p 89), this new numerically-controlled beam and column drill is cutting the cost of making holes in drilled patterns by more than 85% over former layout, spacer-punching, reaming, and radial drilling methods. With this first in a new line of tape-controlled machine tools for the steel fabricating industry, hole patterns are produced to such accuracy that bridge reaming operations on the assembly floor are virtually eliminated.

In addition to its two opposed single spindles and one vertical spindle, the machine consists of a motorized run-in conveyor, a motorized beam feed roller conveyor, and a motorized run-out conveyor. One operator controls the entire production unit which can drill or gun-drill ¾-in. dia holes in steel at feeds to 30 ipm.

Three spindles, under independent N/C control, drill or gun-drill ¾-in. dia holes at up to 30 ipm. Workpiece is positioned by fourth axis of GE control system

A General Electric Mark IV numerical positioning control monitors the advance and clamping of the beam (A-motion) and the positioning and feeding of each of the 3 drill spindles (X, Y, and Z motions). Electrical positioning accuracy of workpiece is ±0.005 in., and of the spindle heads is ±0.0005 in.; both of these are repeatable. Length of travel is about 300 ft for workpiece, and 48 in. for spindle heads.

Floating zeros of up to 0.040 in. on all motions permit location of new or different reference points to allow for mill variations within commercial tolerances. Therefore, it is not necessary to punch a new tape every time a slight shift from the original zero point is required.

Complete machine operating flexibility is provided by three operating methods:

- Tape control, which is described below.
- Dial control, which enables random holes not in the programmed tape to be accurately positioned and drilled in the member.
- Manual control, which permits the operator to jog the drill in forward or reverse directions outside of the automatic drill cycle.

Under tape control, pushing of the cycle start button causes the tape reader in the control console to read the first block of information on the tape. This block includes dimensions for all four machine motions (if required) as well as auxiliary code information for each head.

The machine immediately moves to the command locations, with all motions moving simultaneously. When the A-motion is in position, the part clamps are actuated. Then, as soon as one of the drills moves to start a drill cycle, the next block of information on the tape is read and stored until cycles are completed.

Walter P Hill, Inc, 22183 Telegraph Rd, Detroit 19, Mich

MORE DATA? Circle 61, inside back cover

Standard Hardened Ways Stocked by Ohio Knife

Way sections, available in 12 cross sections in over 80 sizes, permit purchasing of ready-made stock to fit exact machine specifications at a cost said to be significantly lower than making homemade sections.

Flat ways, V-ways, composite die sections, heel and guide blocks, and standard bronze wear plates are available. Each section comes with cutting, forming, or wear surfaces already machined, hardened, and ground. Sections are provided in lengths up to 168 in.

Ohio Knife Co, Dept W, Cincinnati 23, Ohio

MORE DATA? Circle 62, inside back cover

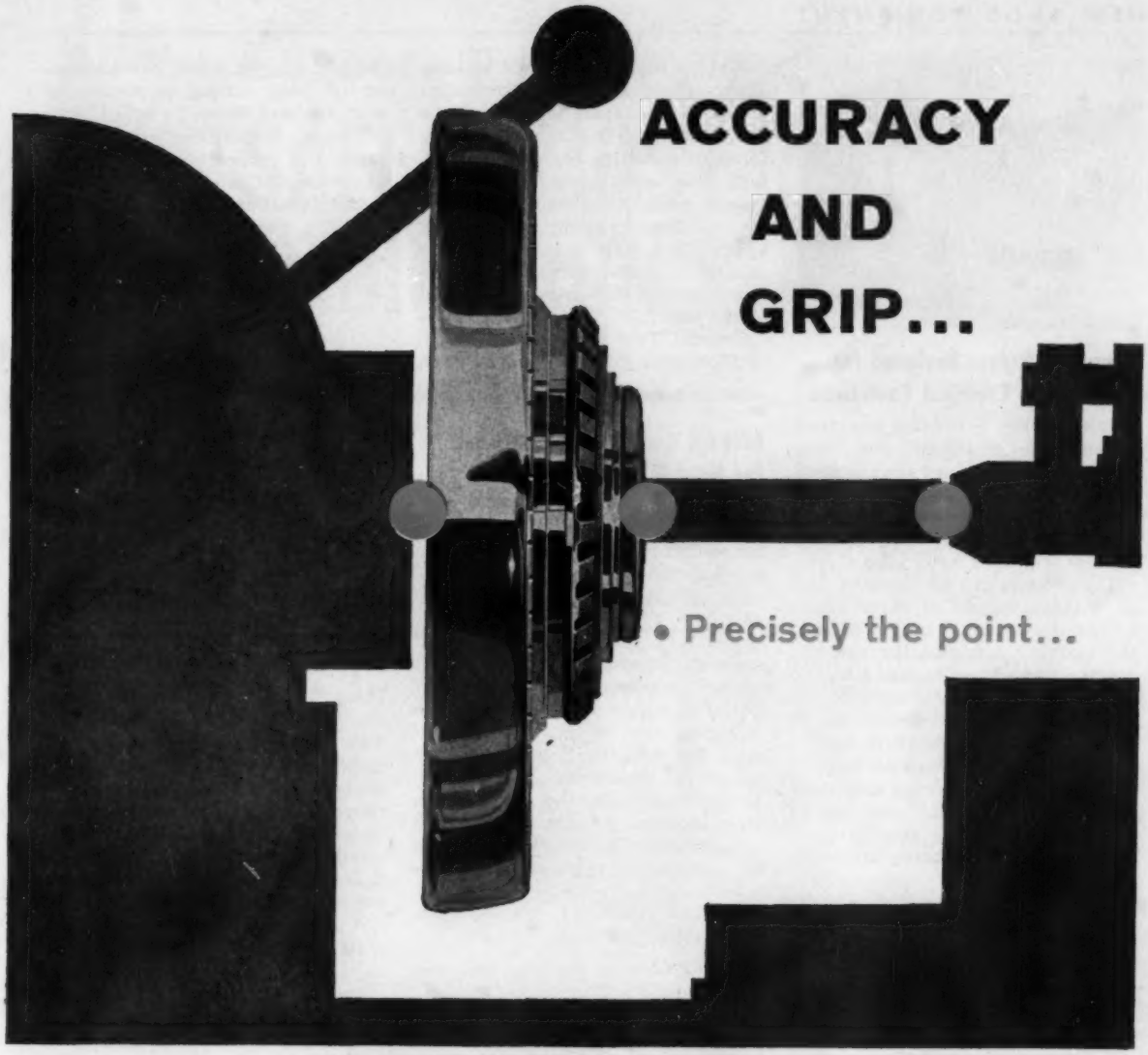
Instant Pick-Up Feeder Orients Tiny Screws to Speed Assembly

This instant pick-up feeder, which consists of a vibrating positioning bowl feeder with funnel feed-up for keeping a constant flow of screws in proper position for contact and instant pick-up by hand or power screwdriver, releases the operator's hands and speeds assembly because it orients tiny screws so that they can be picked up like dipping a pen in an inkwell.

The device, especially applicable for small to miniature size screws, will work with vacuum, magnetic, or spring-clip screwdrivers.

Burklyn Co, 3429 Glendale Blvd, Los Angeles 39, Calif

MORE DATA? Circle 63, inside back cover



When you buy new tools or rebuild old ones

START UP FRONT

- Precisely the point where the tool does its work.
- Precisely the point where profits are made and lost.
- Precisely the point where the accuracy and grip of Jacobs Chucks reduce tool breakage, downtime and rejects.

This is precisely the point, start up front with Jacobs.

The Jacobs Model 91 is the world's finest lathe collet chuck. Developed expressly for the world's finest engine and tool room lathes. Modernize your lathes with Model 91.

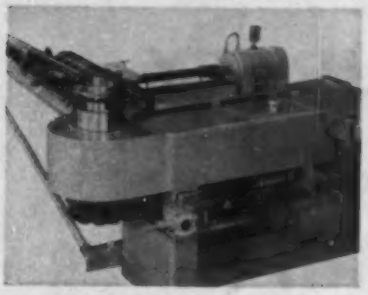
- It has the **range**—each collet has full 1/16" range and set of 11 chucks any bar between 1/16" and 1 3/16".
- It has the **grip**—two to four times as much as split steel collet equipment.
- It has the **accuracy**—the world's most accurate collet chuck. Manufactured to maximum runout limits of .0007"—T. I. R. at the nose.

INDUSTRIAL TEAMWORK

Your industrial supply distributor knows your business. He is always ready to fill your needs quickly and economically. When you need chucks you can depend on this industrial team—Jacobs and your Jacobs industrial supply distributor.

Jacobs CHUCKS

THE JACOBS MANUFACTURING COMPANY,
WEST HARTFORD, CONNECTICUT



Compact Benders Designed for Work Under Cramped Conditions

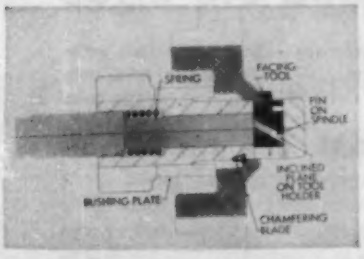
This new series of bending machines, designed for shipboard and other areas where conditions are cramped, is available in 1, 2, and 4-in. models. The 2-in. model shown above has a capacity of 2 in. IPS stainless steel pipe, or 3½-in. x 0.065 tube.

The benders can be operated with or without mandrels. Three levers at operator's control station position the mandrel, advance the pressure die, and rotate the form die. A hinged clamp die secures the work to the form die with 360° contact which exerts clamping pressure through a cam-actuated latch. Because both the clamp die and latch swing open completely out of the way after a bend has been completed, long parts or parts with multiple bends are easier to handle.

The hydraulic system and cylinder comply with latest JIC specifications. Uniformity of identical bends is controlled by a bend angle selector, and bend angle can be repeated consistently with less than ¼° deviation.

Costello Engrg Corp, 1150 W 135th St, Gardena, Calif

MORE DATA? Circle 64, inside back cover



Back Spotfacing Tool Faces Hard-to-Reach Internal Surfaces

Many surfaces not available to conventional machining, or units which require multiple piece-casting design to accommodate internal surface facing, can be faced in one simple operation with a tool that permits internal facing of many assembled products from the exterior.

When a collar on the tool bottoms against the workpiece, continued travel of a spring-loaded spindle exerts pressure on the toolholder, forcing the cutting blade out to perform the facing operation. As the spindle retracts, the blade withdraws into the shank to permit a free return stroke. For parts that also require outside hole chamfering, a removable chamfer blade can be attached to the tool.

Cogsdill Tool Products Inc, 12980 W Eight Mile Rd, Oak Park 37, Mich

MORE DATA? Circle 65, inside back cover

Mill-All Carbide Tools Offered For Hard Machining Operations

Complete line of standard-sized carbide drills, end mills, boring bars, counterbores, and countersinks has size information and suggested operating rpm stamped into the shank of each tool.

A recent case history of use of these tools had to do with a product change involving the component parts of a lock set. The long-run stamping dies on hand were hardened D2 steel, 61 Rhn, and represented a considerable investment. Using these tools, the existing dies were modified without an annealing operation which might have resulted in deformation of the critical tolerance.

Mill-All Co, 150 Marion Ave, Plantsville 11, Conn

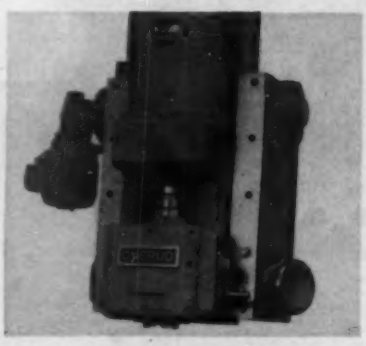
MORE DATA? Circle 66, inside back cover

Combination of Instruments Speeds Accurate Layout

These precision centering and layout instruments are the Gem Center Scope, accurate to 0.001 in. with 6.0 power magnification, that is designed for use as a center finder for drilling precision holes, inspection, and other tooling applications. When combined with the Scribe-Rite, the instruments provide a high degree of accuracy in layout. Scribe Rite, accurate to 0.0005 in., can be used with one or two Gem Center Scopes, depending upon requirements of the job. Applications of the combined instruments include exacting templet work, precise layout of lines, lofting to determine exact size and shape, layout of large drill plates and fixtures, extension or transfer of scribed lines, or re-establishment of reference lines.

Tool Components Inc, 12923 Budlong Ave, Gardena, Calif

MORE DATA? Circle 67, inside back cover



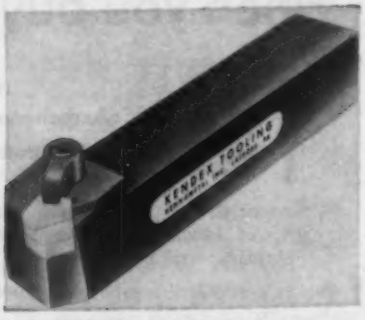
Onsrud Multiple-Speed Mill Heads Available in Two Basic Models

These MH-50 series spindle heads are built in two basic types, each with a choice of 20 or 24 spindle speeds through gear train drive and selection. The first type has a speed range from 12½ to 1250 rpm, the second from 18 to 1783 rpm. Overall dimensions with vertical spindle is only 54-in. high by 20-in. square, yet the head provides a 50 hp drive.

A right angle attachment is supplied if desired for mounting a milling cutter at a 90° angle to the axis.

Onsrud Machine Works, Inc, Machine Tool Div, 7712 Lehigh Ave, Niles 48, Ill

MORE DATA? Circle 68, inside back cover



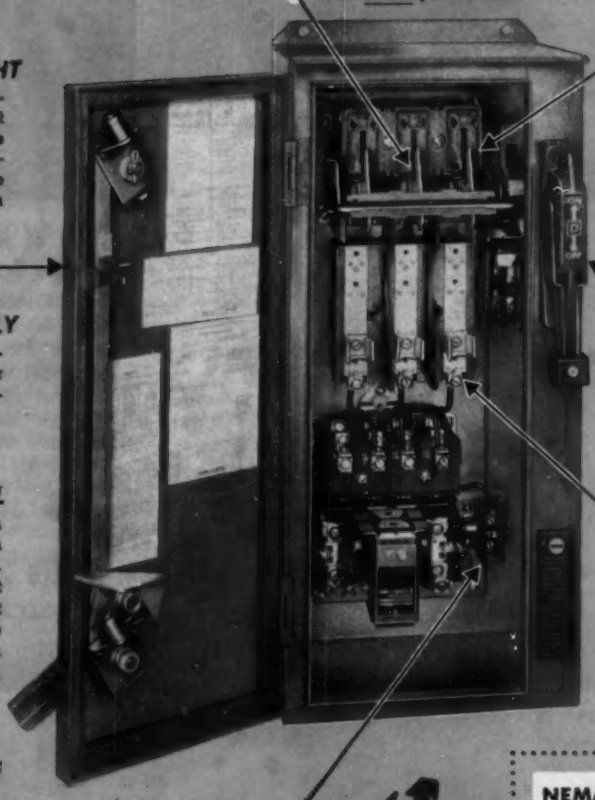
FIVE-SIDED KENDEX INSERTS, with 10 cutting edges, are available in two styles: Style KPD for general turning and KPF for facing. These negative rake throw-away inserts are regular pentagons with nose angles of 108° and have a 30° lead angle—*Kennametal Inc, Latrobe, Pa*

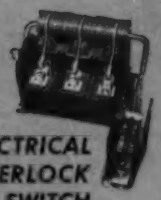
MORE DATA? Circle 69, inside back cover

All these Square D features make this

THE SAFEST, MOST RELIABLE COMBINATION STARTER

VISIBLE BLADES You can see the switch is open and know you're safe!





REALLY DUST-TIGHT
NEMA 5-12 construction keeps out dust and coolant. Positive door-closing mechanism assures complete seal before switch can be operated.

DOOR CLOSES SIMPLY and EASILY
No cover bolts to secure—just push door shut and turn door handle to close and seal.

EASY TO INSTALL
Through wiring with no interference from disconnect switch. Line terminals are at top, load terminals at bottom. Starters can be ganged with less than ½ inch between them.

WIDE RANGE OF SIZES
New Square D combination starter now available in NEMA Sizes 0 through 4.

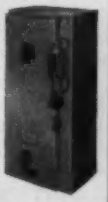
ELECTRICAL INTERLOCK ON SWITCH
Optional single or double-pole interlock available to disconnect separate control circuit power. Assures complete safety!

FOOL-PROOF OPERATING MECHANISM
Handle is permanently attached to switch to eliminate hazard of false handle indication. With door open, the switch can not be operated accidentally.

CONVERTIBLE FUSE CLIPS
If horsepower or voltage requirements change, modification kits provide easy change of fuse clip size and spacing.

3rd OVERLOAD RELAY
Space to add an additional overload relay when desired.

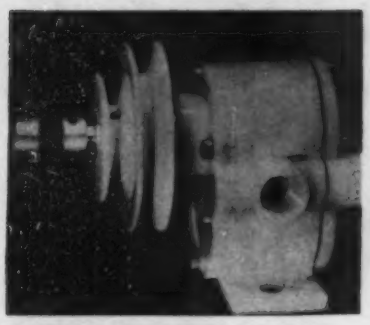
NEMA TYPE 1 ENCLOSURE ALSO AVAILABLE
NEMA Type 1 enclosures, offered in Sizes 0 through 4, can be modified by addition of a pushbutton, selector switch or other accessories. Easy-to-use kits simplify field installation.



Write for Bulletin SM-292. Address Square D Company, Dept. SA, 4041 North Richards Street, Milwaukee 12, Wis.

SQUARE D COMPANY

wherever electricity is distributed and controlled



Pump, With All Plastic Parts, Costs Less, Handles All Liquids

All major parts of this new pump—including the housing, gears, bearings, cover plates, relief valves, and drive sheave—are molded to close tolerance from Delrin a new thermoplastic developed by DuPont.

The pump, which is capable of pumping any liquid, not only costs less than conventional metal pumps, according to the manufacturer; it also has greatly reduced maintenance costs. The tight tolerances all but eliminate wear on gears and side plates caused by tolerance accumulations. In addition, none of the moving parts receive high stress during normal pumping operations.

Key to the low cost is the simplicity of its design and mass production of plastic parts, rather than the precission machining of metals. Because of mold design, and uniform shrinkage of the plastic, the company achieves tolerances of two- to three-thousandths of an inch.

Artag Plastics Corp, 2853 Irving Park Rd, Chicago 18, Ill

MORE DATA? Circle 70, inside back cover

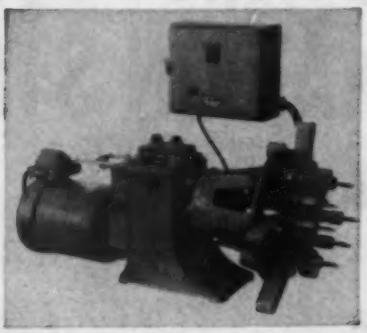
Small Diameter Tubing Supplied In Straight and Reverse Tapers

Small diameter straight and reverse tapered tubing, furnished with either constant or tapered wall, ranges in size from 0.080 to 1.500-in. OD with wall thicknesses from 0.012 to 0.0625 in. Reverse tapered tubing is furnished in two forms: tapered from the middle to both ends, and tapered from the ends to the middle. Straight tapered tubing is tapered continuously from one end to the other.

Product is available in any material that can be readily cold-worked from company's line of more than 120 standard and special analyses which include carbon and alloy steels, stainless steels, nickel and nickel alloys, beryllium copper, and the reactive metals such as titanium and Zircaloy. Both straight and reverse tapers come in lengths up to 10 ft. A surface finish of 65 microin. or better is obtainable.

Superior Tube Co, 1568 Germantown Ave, Norristown, Pa

MORE DATA? Circle 71, inside back cover



Multiple Adjustable Tapping Unit Operates in Any Position

Anoka machine, with capacity of 6 NC ⅜-in. taps in free cutting steel, can operate singly or in units from different sides or in clusters with other machines from a single built-in switch.

The unit has six spindles adjustable to any pattern, with a maximum bolt circle of 7½ in. and a minimum center distance of 1¼ in. It can operate in any position, with the built-in auxiliary switch permitting synchronization with additional Anoka units, with index tables, or other apparatus. Special bracket adaptors are also available for mounting on drillpress columns. Built-in pressure switch at the leadscrew nut permits reversal and backoff in case of a missing hole in a workpiece or a misalignment of taps. One set of six collets is furnished. Maximum stroke is 3 in., minimum stroke, ⅝ in. Price is $1485 fob.

Columbia Tool & Die Works, 716 39th Ave, NE, Minneapolis 21, Minn

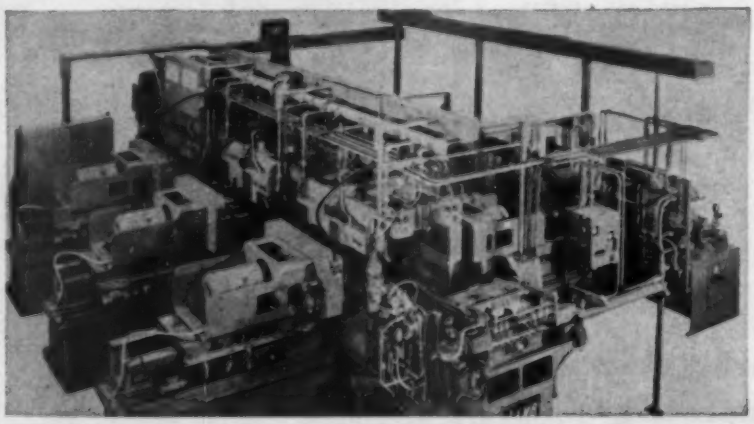
MORE DATA? Circle 72, inside back cover

Variety of Air-Powered Tools Available From Stanley Works

Among the air-powered tools recently introduced by Stanley are the Unishear metal cutting unit, a 12-gage model with air trigger throttle to control speed, cutting rate of up to 12 fpm, and automatic start-stop lubrication from oil reservoir in the handle. Air-powered motors and routers are designed for speed under load which provides uniform work.

Stanley Electric Tools, Div of Stanley Works, New Britain, Conn

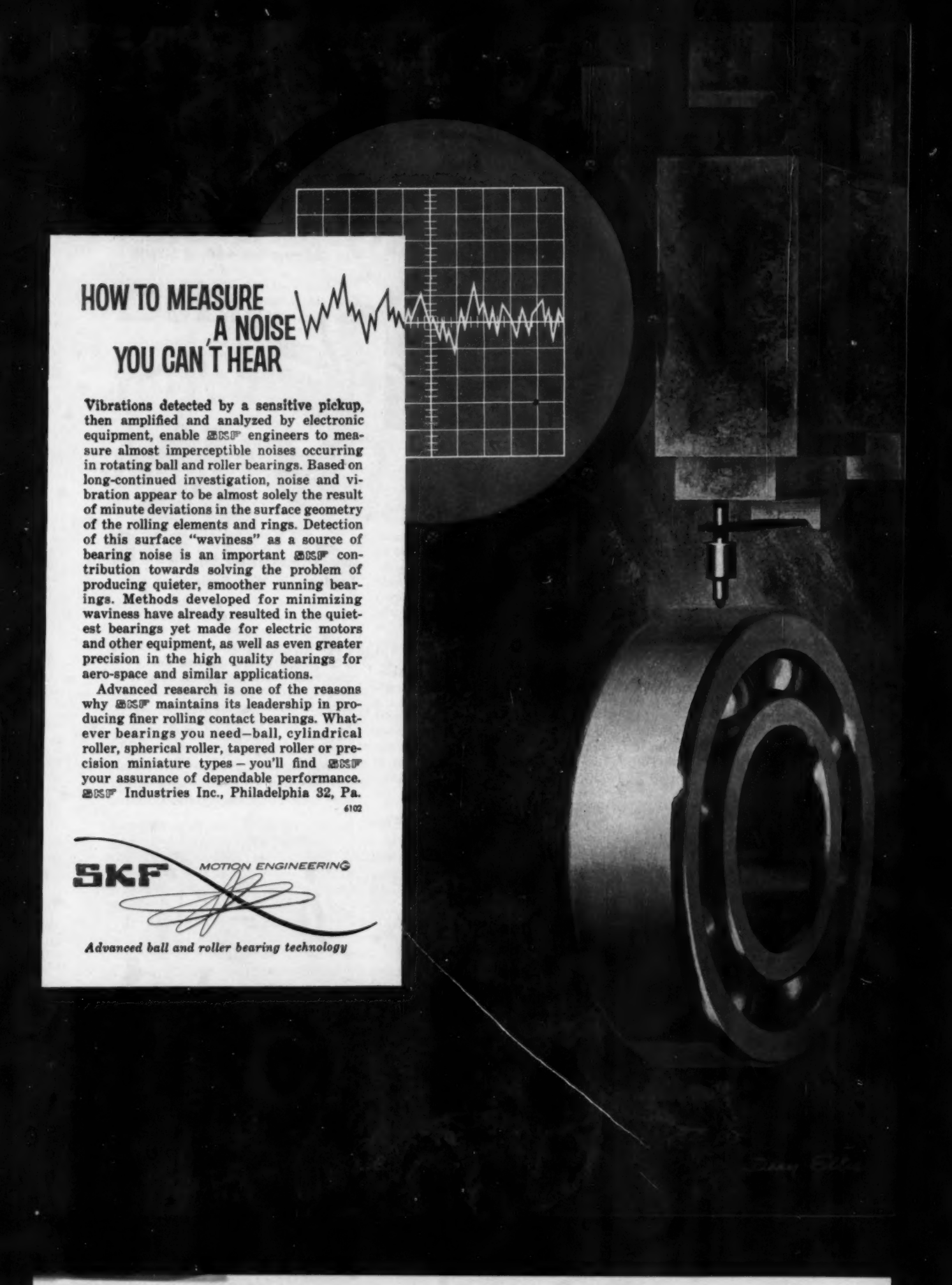
MORE DATA? Circle 73, inside back cover



12-STATION TRANSFER MACHINE performs rough, semi-finish, and finish operations in front and rear faces of die cast aluminum cylinder blocks. All holes—including dowel, water pump impeller, camshaft, transmission case, and front cover mounting holes—are machined in a 27.5 sec cycle, producing 131 blocks an hr—*F Jos Lamb Co, 5663 E Nine Mile Rd, Detroit 34, Mich*

MORE DATA? Circle 74, inside back cover

CIRCLE 218 READER SERVICE CARD ►



HOW TO MEASURE A NOISE YOU CAN'T HEAR

Vibrations detected by a sensitive pickup, then amplified and analyzed by electronic equipment, enable SKF engineers to measure almost imperceptible noises occurring in rotating ball and roller bearings. Based on long-continued investigation, noise and vibration appear to be almost solely the result of minute deviations in the surface geometry of the rolling elements and rings. Detection of this surface "waviness" as a source of bearing noise is an important SKF contribution towards solving the problem of producing quieter, smoother running bearings. Methods developed for minimizing waviness have already resulted in the quietest bearings yet made for electric motors and other equipment, as well as even greater precision in the high quality bearings for aero-space and similar applications.

Advanced research is one of the reasons why SKF maintains its leadership in producing finer rolling contact bearings. Whatever bearings you need—ball, cylindrical roller, spherical roller, tapered roller or precision miniature types – you'll find SKF your assurance of dependable performance. SKF Industries Inc., Philadelphia 32, Pa.

6102

SKF MOTION ENGINEERING

Advanced ball and roller bearing technology

Machine Speeds Spotting-In on Dies and Molds by up to 70%

The new Tilt-A-Die is said to eliminate die and mold-room bottlenecks because it safely speeds spotting-in time on dies and molds up to 70%. Essentially, the device works as follows:

An elevating bed and lower platen accurately ride on four, 4-in. dia guide bars, with the crown stationary. Die halves are secured to movable platens and are easily rolled from crown and bed—on hardened steel ball bearing rollers—to tilting position.

Upper and lower platens swing in vertical arcs as much as 220°; each platen is positively located and mechanically locked at the desired angle, in seconds, for spotting-in. Thus, either or both of the halves may be tilted to the most efficient working position.

Sanders Tool & Production Co, 4030 Fitch Rd, Toledo 13, Ohio

MORE DATA? Circle 75, inside back cover

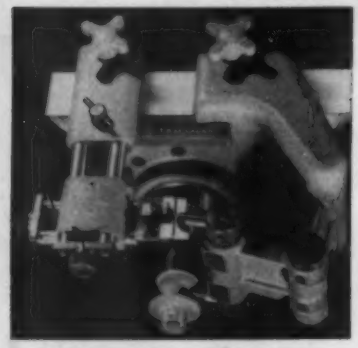
Welder Line Designed For Thin Metals

Line of equipment includes six different stored energy power supplies and five different weld heads and handpieces. Sizes and ratings are designed to enable selection of a setup to meet any of the needs of manufacturers of relays, tubes, transducers, pots, thermocouples, and high density component packages.

Welding power supplies include ultra short discharge time, fully metered controls, input voltage regulation. and a packaging concept that allows all units to be used on standard production benches without need for special installations. Weld heads feature the lowest possible inertia in order to insure quick follow-through on all welds. All are pressure sensitive to insure that present electrode pressures are reached before discharging the weld energy.

Hughes Aircraft Co, Vacuum Tube Products Div, 2020 Short St, Oceanside, Calif

MORE DATA? Circle 76, inside back cover



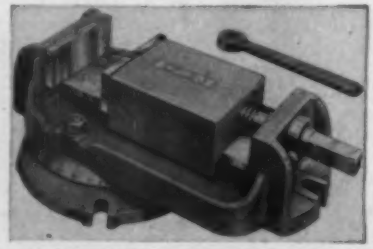
Contour Wheel Dresser Is 1:1 Ratio Templet Tracer

Tracaform Model SMD-704 is a spindle-mounted unit capable of dressing complex shapes in grinding wheels to tenths accuracy. It is a 1:1 ratio templet tracing model designed to fit most surface grinders using a 7-in.-dia wheel or less. It will dress wheels from 7-in.-dia by 4-in. wide down to the smallest mounted wheels. Mounting casting is bored to fit a 3-in.-dia standard spindle and clamps by screws.

The templet is mounted on a two-way templet slide which permits controlled feed of the diamond into the wheel. Intricate forms can be dressed into the wheel repeatedly without losing location or disturbing the work being ground. Feed knobs of the Tracaform are graduated in 0.001. Dresser can be used also for straights, angles, and steps.

Tracaform Corp, 11380 Kaltz, Warren, Mich

MORE DATA? Circle 77, inside back cover



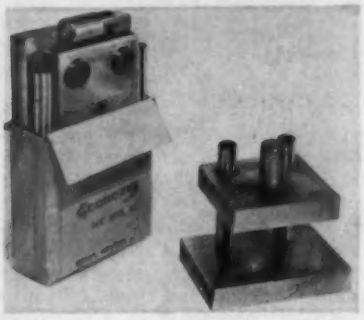
4½-in. Milling Machine Vise Available From Wilton Tool

Features of the new unit include a generously proportioned coolant trough; replaceable steel gib plate; reversible steel jaw faces—one side is smoothly ground surface and the other has vertical and horizontal V-slots.

Model is furnished in a stationary flanged base style or with a graduated swivel base. The stationary base unit weighs 50 lb and has overall height of 4¾ in. Swivel base model is 61 lb. Both models open to 4 in. and have jaw depth of 1-15/16 in.

Wilton Tool Mfg Co, 9525 Irving Park Rd, Schiller Park, Ill

MORE DATA? Circle 78, inside back cover

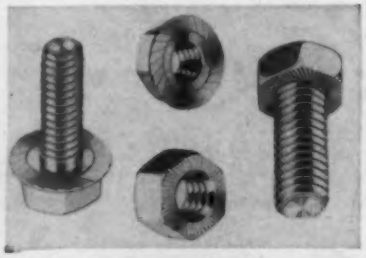


Line of Compact Die Sets Available in Nine Basic Sizes

Line of all-steel die sets features a choice of three common lengths of ground and hardened pins, 5, 6, and 7 in., and two shank sizes, at no extra cost. Overall die area dimensions range from 6 x 4 in. to 15 x 12 in. They are shipped knocked down in a kit, enabling the user to spot die sections and to drill or machine the holder as required before the pins are installed.

Wheatley Economy Die Sets Inc, 1627 W Fort St, Detroit 16, Mich

MORE DATA? Circle 79, inside back cover

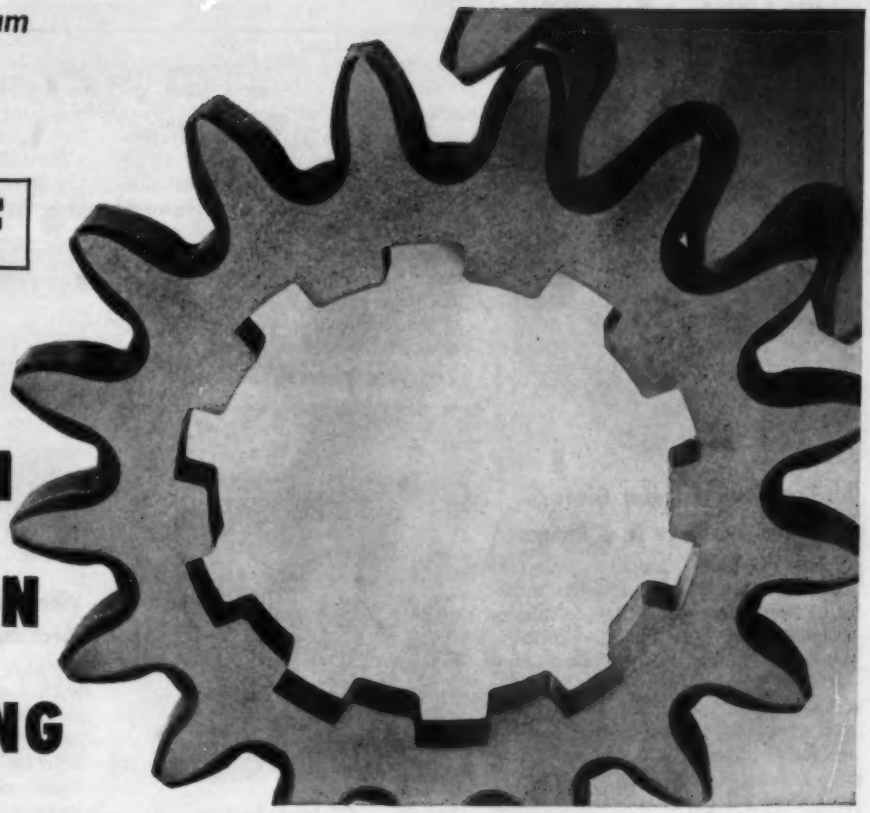


WHIZ-LOCK SCREWS AND NUTS' bearing faces have a series of spiral serrations on a convex base that takes a firm grip when the nut is tightened. Flange nuts or screws can be specified for oversize holes where bearing surface is limited—*MacLean-Fogg Lock Nut Co, 5535 N Wolcott Ave, Chicago 40, Ill*

MORE DATA? Circle 80, inside back cover

at Farrel-Birmingham

NEW S&F TOOTH-TO-TOOTH INDUCTION HARDENING



Typical hardening pattern along flanks and through root.

...produces toughest gears yet!

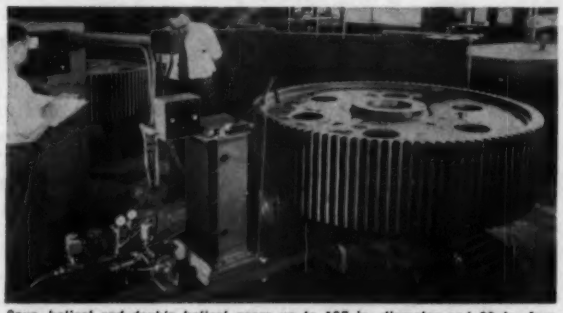
There's nothing like the S & F method of tooth-to-tooth gear hardening. Not only does it add amazing durability to big gears, but load-carrying capacity is vastly increased. Warpage can be insignificant depending on gear design. And there can be substantial savings in material and machining costs!

Farrel-Birmingham tells us that in one installation large gears with S & F induction-hardened teeth have already gone through over two years of rugged service with absolutely no sign of wear—whereas formerly, gears had to be *replaced* every two years. Reports of other installations are also highly satisfactory.

Precision controls maintain constantly accurate time, current, feed and distance between coil and workpiece to assure consistent results. In a group of similar gears, all portions of all teeth will have the same predetermined case contour and depth of hardness. In fact, hardening depth is so accurately controlled and warpage so minute that, for a number of gears, no additional machining is required.

S & F induction hardening units capable of handling gears from 3 in. to 20 ft. in diameter and larger, are available in semi-automatic and automatic models.

Want to know how this revolutionary approach to gear hardening can fit your production? Just ask us about it.



Spur, helical and double helical gears up to 157 in. diameter and 20 in. face widths are induction hardened tooth-by-tooth in this S & F equipment at Farrel-Birmingham, Ansonia, Conn.

KO CO., INC. PRECISION MACHINERY

KURT ORBAN COMPANY, INC.

36 Exchange Place, Jersey City 2, New Jersey

All-Transistor Monitor Gives Vibration Readings in 3 Ranges

Vibration monitor, Model V/p-2 (for $320), will serve as vibration indicator and protection device when coupled with $270 vibration pickup. Also, the manufacturer offers discounts on quantity purchases.

For monitoring of both heavy duty and precision machines, the transistorized monitor provides three vibration ranges: 0 to 0.1 mils (100 micro-in.), 0 to 1.0 mil, and 0 to 10 mils. Contacts for alarm and shut down functions are relayed from a set-point through a single-pole relay which actuates 2 amp contacts. Set-points may be made at any percentage of the three vibration ranges.

In the most sensitive range—0 to 100 micro in., peak-to-peak—it is possible to measure vibration amplitudes below 10 micro-in., and to detect changes as slight as 1.0 micro-in.

Indikon Company, 76 Coolidge Hill Rd, Watertown 72, Mass

MORE DATA? Circle 81, inside back cover

Uncoiler and Recoiler Machines Offered to Metalworking Market

The Uncoiler has four self-centering arms of welded steel which can be expanded from 18 to 24-in. dia, operated by turning a crank. Total expansion requires about 22 turns. Optional features are power drive and loop control arms.

The Recoiler has a drum consisting of four 90° sector arms with approximately 1-in. space between them when the arms are collapsed to the minimum diameter of 18 in. Expanded diameter is 22 in. The spindle drive on this machine (optional on the Uncoiler) consists of a 3-hp motor and V-belts driving up to a worm shaft through an electric clutch.

F A Woehr Machine Corp, 17 Favor St, Rochester 8, NY

MORE DATA? Circle 82, inside back cover

Drillpress Coolant System Has On-Off Drill Spray

The Drill-Spray can be attached to any 14 or 15-in. drillpress on the foot of the depth stop rod. A valve in the unit turns the spray on when the drill is fed into the work and shuts it off when the feed lever is released. The unit includes a pressure regulator so that any available shop air supply can be used. System travels up and down with the drill chuck, keeping the spray nozzle aimed on the drill flutes; in no way does it restrict full use of the drillpress if coolant is not needed. When desired, it can be adjusted for a dry air blast to keep chips away from the work area.

The Drillco Table with T-slots serves as a coolant storage and return tank; it replaces the table supplied with the drillpress and uses the original column clamp.

Dirigo Compass & Instrument Co, Drillco Div, Boeing Field, Box 37, Seattle 8, Wash

MORE DATA? Circle 83, inside back cover

Plated Fasteners Added To Stanscrew Line

Plated fastener line includes hex cap screws, hex and hex screws, carriage bolts, lag screws, and hex nuts. Selection includes more than 250 different types and sizes. They are particularly useful in applications requiring extra corrosion resistance. Zinc plating is used for the finish.

Standard Screw Co, 2701 Washington Blvd, Bellwood, Ill

MORE DATA? Circle 84, inside back cover

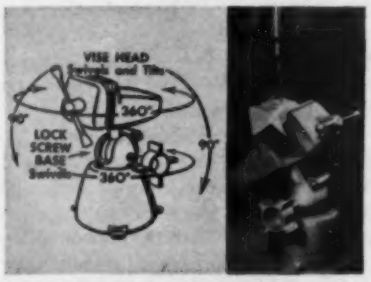
Vibratory Finisher Incorporates Mechanical Motion Control

The 1½ YA self-contained machine with work container capacity of 1½ cu ft is designed as a production unit for finishing small parts and is suitable for a variety of applications on metal, plastic, and ceramic items. It incorporates mechanical motion control for infinite variation of frequency over the available range while the machine is running.

The rubber-lined work container holds up to 500 lb of media and workpieces and is supported by a system of air cushions. Amplitude as well as frequency is variable. When placed on air-cushioned floor mounts, no vibration is transmitted to the floor.

Pangborn Corp, Vibratory Finishing Div, Hagerstown, Md

MORE DATA? Circle 85, inside back cover



PANA VISE holds work at any angle, has 2½-in. wide jaws that open 2½ in. Removable vise head fits into positioning base on ⅝-in. dia post. Complete unit sells for $14.95—*Colbert Die Cast Co, Inc, 10107 Adella Ave, South Gate, Calif*

MORE DATA? Circle 86, inside back cover

POP'S school of Filing

PICTURE ALL 6000 FILES ON THE WALLS OF THE SHOP-- MY, WHAT A SIGHT THAT WOULD BE!
POP WOULD PROBABLY HAVE THE CEILING COVERED WITH FILES, TOO!
THAT'S ONE USE THE NICHOLSON PEOPLE NEVER THOUGHT OF!

Nicholson and Black Diamond files weren't designed for wall or ceiling covering . . . but to the busy shop man, a complete set of files for his particular requirements is always a pleasant sight . . . and quite often less than a half dozen versatile file types will do.

The Nicholson or Black Diamond Mill Bastard file is a good example of versatility. It's single cut for draw filing, tool sharpening, smooth finishing of metals and dozens of other uses . . . and it looks good on a wall even without the other 6000 Nicholson or Black Diamond files.

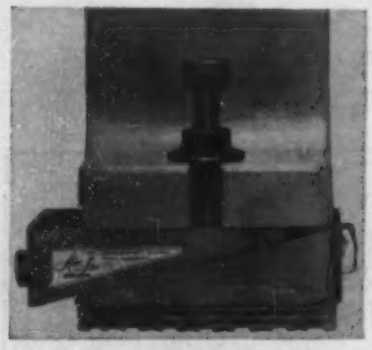
Try these files today*. Remember there's a Nicholson or Black Diamond file for every industrial requirement.

File Filosophy free on request. Write to Department A. M.

* Industrial Distributors provide the finest goods and services in the least possible time. Our products are sold exclusively through them.

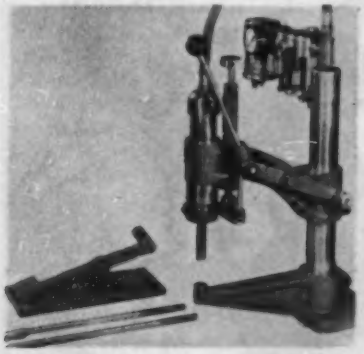
NICHOLSON NICHOLSON FILE COMPANY, PROVIDENCE 1, RHODE ISLAND

FILES • ROTARY BURS • HACKSAW AND BAND SAW BLADES • GROUND FLAT STOCK • INDUSTRIAL HAMMERS



BOLT-ON WEDGMOUNT attaches to any machine which is then equipped with a vibration controlling mount and leveling device. The Wedgmount becomes an integral part of the machine and is moved with it from one position to another — *Clark-Cutler-McDermott Co, Franklin, Mass*

MORE DATA? Circle 87, inside back cover



Pneumatic Impact Machine Has 9-in. Throat, Horn-Type Anvil

Model 150-RHP-090 bench mounted machine is a vibrating or repeating hammer with pedal or hand lever operation. Valving is internal, and contact pressure of the tool on the work actuates it.

As long as contact pressure is maintained, the hammer will repeat, with rate varying from 3000 to 6000 times per minute according to air pressure used. Action may be regulated from a gentle vibration to a riveting capacity of ⅛ in. in mild steel.

An adjustable depth stop may be set to limit work progress. When the tool reaches the designed depth, the hammer action fades out. The tool is keyed against rotation and is held in place by the spring loading of the key. Tool and anvil buttons are available for all types of use.

Heidrich-Nourse Co, 631 E Third St, Los Angeles, Calif

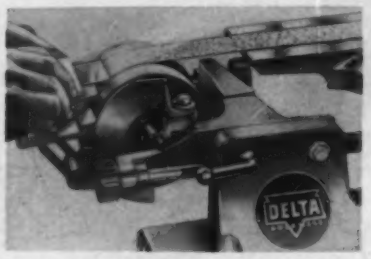
MORE DATA? Circle 88, inside back cover

Shell End Mills Designed for Light-Duty Milling Machines

Line of cutters ranging in size from 2½ to 4-in. dia uses throw-away indexable carbide inserts. Cutters are adapted for square and triangular, positive and negative rakes. A style is also available with a positive rake insert for 90° shoulder cuts. Designed to fit standard adapters of 1, 1¼, and 1½-in. dia, they have hardened steel anvils, carbide chip deflectors, and K locks which prevent the inserts from being thrown from the cutter.

Greenleaf Corp, Newcomer Tool Div, Saegertown, Pa

MORE DATA? Circle 89, inside back cover



Plane Blade Grinding Attachment For Belt and Disk Finisher

Attachment permits precision sharpening of plane blades, wood chisels, cold chisels, screwdrivers, knives, and other cutting tools on the belt of this machine. A 2-in-wide aluminum oxide belt, used instead of the standard 4-in. belts for sanding and grinding, is supplied with the attachment.

The Delta belt and disk finishing machine provides a 12-in. disk and a 4-in. belt powered by a single motor for use in all types of finishing operations. Price of the plane blade grinding attachment is $15.90.

Delta Power Tool Division, Rockwell Mfg Co, 482 N Lexington Ave, Pittsburgh 8, Pa

MORE DATA? Circle 90, inside back cover

Pneumatic Collet Fixture Has No End Movement

Premeco fixture uses 5C collets in either the standard or pot collet sizes. Lack of end movement, regardless of the diameter of the work placed in the collet, controls a uniform depth when milling, drilling, tapping, and similar operations. Collets are easily changed without moving the fixture which uses normal shop air pressure of 100 to 200 psi. Unit is 5 in. in dia at the base with a total height of 3 7/16 in. A through hole permits chips and coolant to pass out through the bottom.

Precision Mechanisms Corp, 917 Meridian Ave, South Pasadena, Calif.

MORE DATA? Circle 91, inside back cover

Industrial Cleaning Tanks Available in 50-gal Capacities

Heat-Master line features full insulation, fused link closing device, scum gutters, natural rolling boil action, heavy parts grill, and draw-off for sludge. Units are furnished in capacities of 50 gal and up and can be heated by electricity, gas of all types, steam, and kerosene.

Aeroil Products Co, 69 Wesley St, South Hackensack, NJ

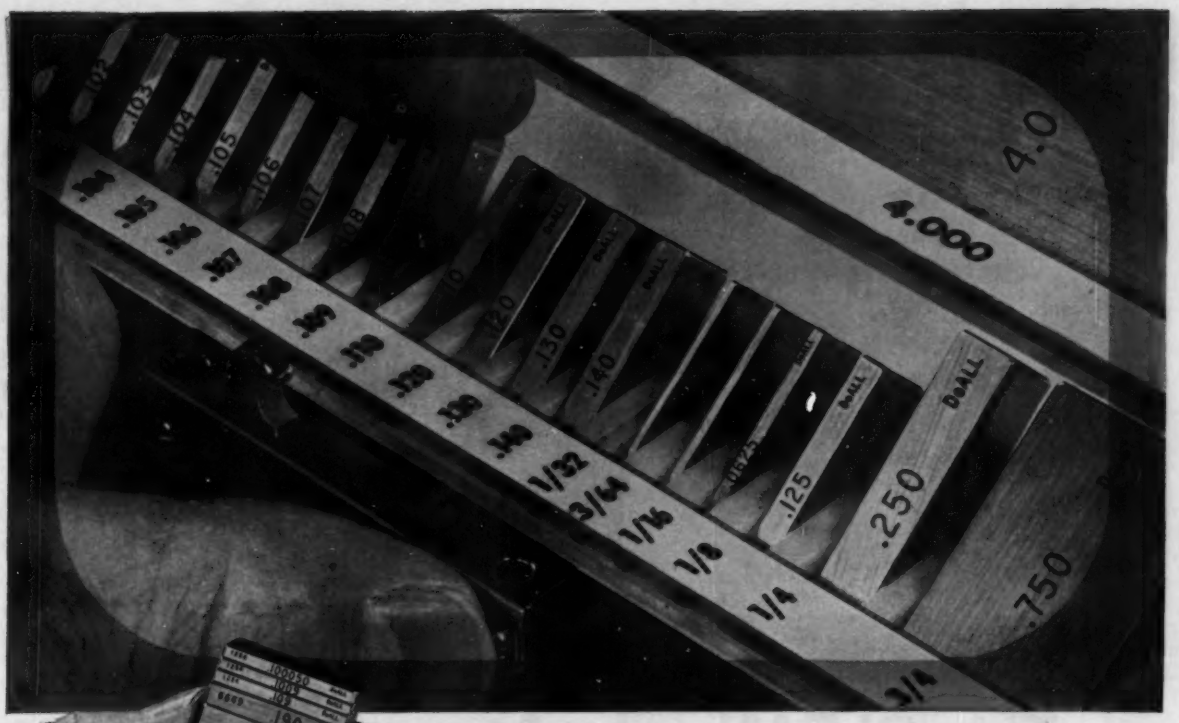
MORE DATA? Circle 92, inside back cover

Depressed Center Disk Wheels Are Reinforced Resinoid Type

Alpha wheels are rigid design, made from abrasive grain and resinoid bond with triple reinforcement. They are available in 7 and 9-in. diameters, ⅛, 3/16, and ¼, and ¾-in. thickness. They have a ⅞-in depressed center hole and are furnished in a complete range of grain size from 14 to 120.

Atlantic Abrasive Corp, South Braintree 85, Mass

MORE DATA? Circle 93, inside back cover



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Demonstration
IRE Show
March 20-23
New York Coliseum

. . . YOUR BEST BUY
DoALL *STAINLESS STEEL*
GAGE BLOCKS

See these new gage blocks made of stainless steel. At a cost only slightly more than regular blocks and less than chrome carbide or chrome-plated blocks—you get guaranteed performance and *Assured Accuracy*.

Here's why:

- HARDNESS—Over 68 Rockwell C any place on block surface.
- WEAR—More than three times the life of ordinary steel blocks.
- CORROSION RESISTANCE—Up to five times greater than steel blocks.
- SURFACE FINISH—.09 microinch AA.
- WRINGABILITY—Much better than ordinary steel blocks.
- COEFFICIENT OF EXPANSION—In the range of most steel materials.
- BRINELLING—Spindle impacts do not brinell DoALL stainless steel blocks.

Plus these bonus features:

Size —marked on the side of each block—visible when wrung.

Case —new, self-indexing, easy to use. Eliminates touching gaging surfaces of blocks.

Care —complete maintenance kit for care of gage blocks.

Certified—Certificate of Inspection covering each block in set.

DoALL stainless steel gage blocks are available in standard sets with AA and A+ accuracies.

Call your local DoALL store today. Ask your DoALL Gage Specialist to demonstrate the new stainless steel gage blocks.

GB-39

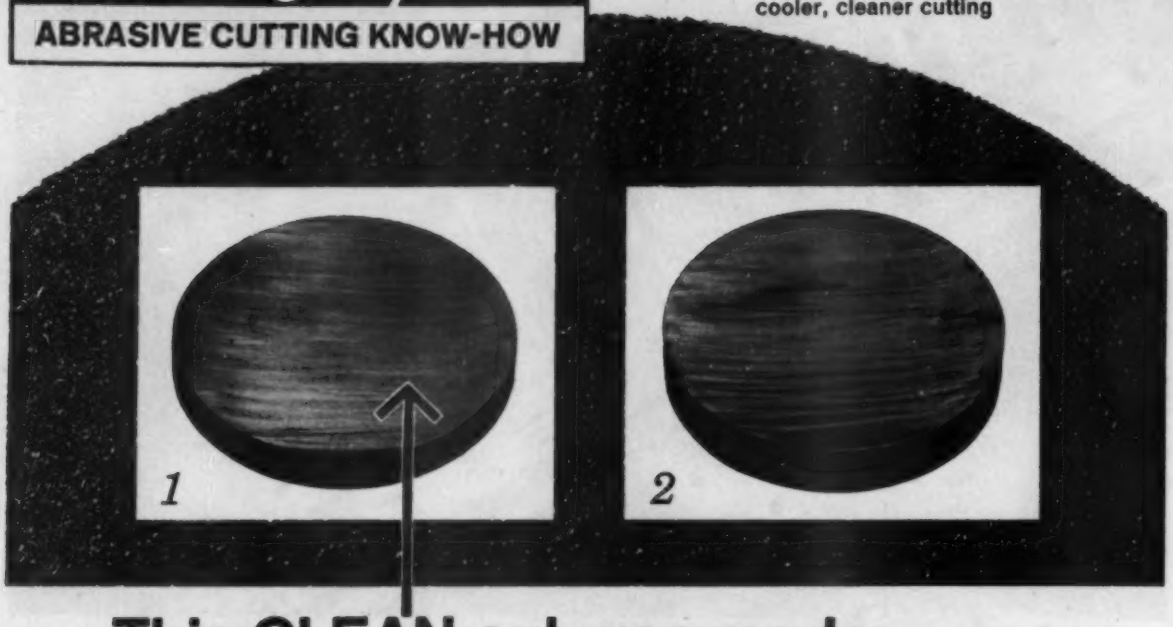
This is a typical DoALL Store

The DoALL Company, Des Plaines, Illinois

Allison-Campbell

ABRASIVE CUTTING KNOW-HOW

Close-up view of resinoid wheel shows rough texture that provides cooler, cleaner cutting

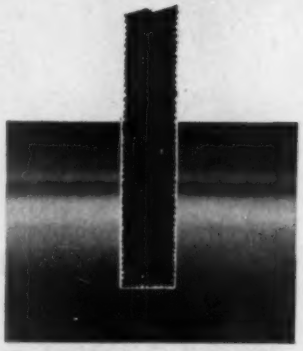


This CLEAN cut was made with a ROUGH-SIDED wheel!

1 • **THE SPECIMEN ON THE LEFT ABOVE** was cut from a 3¾" diameter hardened steel bar in just 28 seconds with an ALLISON *rough-sided* dry abrasive cutting wheel like the one shown in the background. Note that the cut is clean and practically burn-free.

2 • The specimen on the right was cut under the same conditions and with a wheel of the same formulation, but *without* rough sides. The result—the cut took 30 seconds and produced a badly burned surface.

3 • The secret is the extra clearance the rough sides give *inside* the cut (as shown in the small picture at right), and the resulting *cooler* cutting action. This adds to wheel life, too. That's why, for the dry abrasive cutting of solid bars, heavy-wall tubing and structural shapes, ALLISON-CAMPBELL field engineers generally recommend rough-sided wheels.



3 Inside the cut, rough-sided wheels give extra clearance, extra cooling for faster cutting and to prevent burning

For dry cutting of thin-wall tubing with minimum burr, a fine-grit, *smooth-sided* wheel is the choice. And for *wet* abrasive cutting, dozens of ALLISON wheel specifications are available to match the material you are cutting, the quality you require, and the cut-off machine you use.

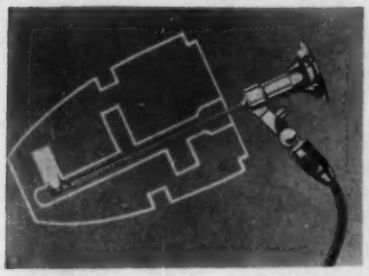
Regardless of your cut-off problems, your ALLISON-CAMPBELL field engineer can help you choose the wheels that will give the results you want. He is an abrasive cutting specialist—use his know-how.

Write for **Bulletin DH-214A** *for details on the complete line of ALLISON wheels*

ACCO

ALLISON ABRASIVE CUTTING WHEELS

Allison-Campbell Division • American Chain & Cable Company, Inc.
923 Connecticut Avenue, Bridgeport 2, Conn.



Miniature Borescope Inspects Holes Down to 0.145-in. Dia

This new miniature borescope—with a shaft length of 4 11/16 in. and a shaft diameter of 0.145 in.—is said to provide a means of inspecting very small bores where no other method is possible.

Right angle vision is provided through a lens system of high optical efficiency which produces a magnified image that is corrected and sharply defined. Power is supplied by battery handle or transformer.

Welch Allyn Inc, 196 Jordan Rd, Skaneateles Falls, NY

MORE DATA? Circle 108, inside back cover

Three Stub Boring Tool Sets Designed for 7/16 to 18-in. Range

Sets contain Davis Super-Mike precision micrometer-adjustable flycutter bars and tooling. The Super-Mike feature permits positioning of cutters in the bars to an accuracy of 0.0001 in., and eliminates the need for cut-and-try toolsetting on close-tolerance work. Sets have bar diameter-to-length proportions for maximum cutting performance and can utilize SHSS, TCT, or Davis throw-away insert Super-Mike cutters.

Continuous-feed heads for boring, facing, turning, counterboring, backfacing, grooving, and chamfering are also included in the two largest sets. These heads provide continuous radial tool feed and have a working range of 7/16 (with pencil boring tool) to either 10 or 18 in., depending on size of the head.

Davis Products, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis

MORE DATA? Circle 109, inside back cover

WEDGMOUNT LEVELING MACHINERY MOUNTS

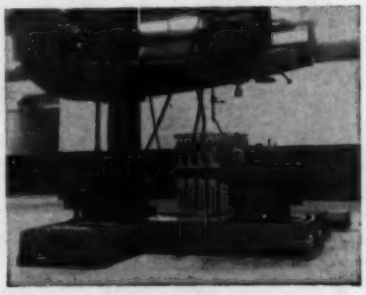
You can now effectively dampen and isolate the vibration, shock and noise of any machine with Wedgmount machinery mounts.

Wedgmounts are manufactured in a wide range of sizes and capacities so that it is possible to control the vibration of any type of machine tool — from punch press to grinder.

Wedgmounts are installed without bolts or cement and installation takes but a matter of minutes. Because of their opposing wedge construction, Wedgmounts are easily leveled by means of an adjusting bolt — no need for shimming.

Other models, retaining the leveling feature, are available to use where bolting to the floor is mandatory, or where it is desired to make the mount an integral part of the machine.

Write for full information about Wedgmount leveling machinery mounts.



* The photograph above is from an actual Wedgmount installation. It is one of eight 4" x 8" Type S Wedgmounts supporting a Cincinnati-Bickford 6 foot radial drill, shown at left.

Air-Loc® DIVISION

Clark, Cutler, McDermott Co.

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457 WEST FORT ST.
DETROIT 26, MICH.
TWX DE899 WO 3-7913

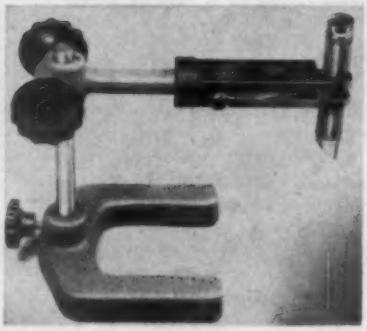
Dual Spindle Boremation Unit Halves Production Time

Dual spindle gun-drilling power unit reportedly will cut production time in half on certain operations. Workpieces that will lend themselves to close center fixturing are ideal for this type of setup. At a cost of approximately 10% over comparable single spindle units, this model will achieve 80% more production in all but very unusual cases, manufacturer claims. Finished holes can be drilled from solid materials in one pass on a production basis. Diameter to length ratios as high as 288:1 are possible with a minimum runout of 0.0002 per inch. Designed for production use, these units readily adapt to one-of-a-kind or semi-production work with both or one spindle operation.

The Dual is available with hydraulic or positive drive mechanical transmission on the 12 and 24-in. strokes. A mechanical transmission is mandatory for the longer 36, 48, and 60-in. units. Infinitely variable feed rates from 0.0001 ipr to 30 in. per minute can be coordinated to operate with spindle speeds up to 10,000 rpm.

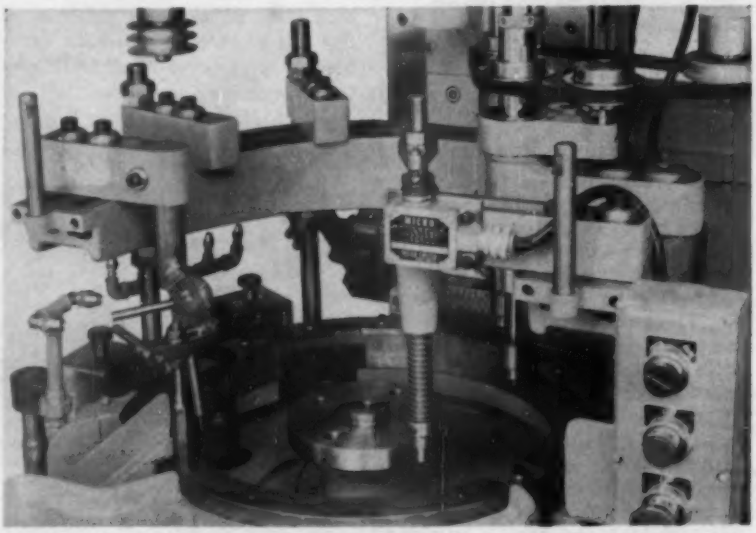
Drillmation Co, 6500 E 11 Mile Rd, Center Line, Mich

MORE DATA? Circle 110, inside back cover



INDUSTRIAL MEASURING MICROSCOPE sells, with stand, for just below $20. The 50X instrument, which can be adjusted through a full 360°, has a reticle calibrated to measure 1/10-in. by 0.001-in. divisions. Price is $19.75, postpaid—*Edmund Scientific Co, Barrington, NJ*

MORE DATA? Circle 111, inside back cover



ADJUSTABLE INVERTED COUNTERSINKING SPINDLES increase the flexibility of these dial-type machines. The new spindles, designed for countersinking and chamfering operations, are adjusted in the same way as a cutting tool in a lathe post. This close-up shows the spindles as they appear underneath the indexing dial—*The Bodine Corp, 317 Mountain Grove St, Bridgeport 5, Conn*

MORE DATA? Circle 112, inside back cover

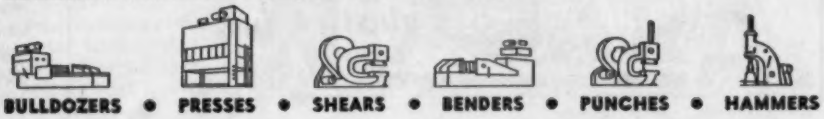
Parts formed by 100-ton Williams-White Bulldozer at Chicago plant of Joslyn Manufacturing and Supply Company. Holes are drilled in previous operation.

150% production boost -- 2 steps eliminated with Williams-White hydraulic Bulldozer

The job: Form a hot rolled steel workpiece, ½" x 4" x 42", in one operation. Previously, this tough assignment took 3 strokes of a press. Production rate was 40 parts per hour. NOW — a 100-ton Williams-White Bulldozer with hydraulic cushion, utilizing special tooling by Joslyn engineers, forms the hot steel in one squeeze. Current production rate: 100 parts per hour. The production increase and elimination of 2 steps in this application are typical of results gained with Williams-White heavy machinery and skillful tooling. Check into the time and money-saving advantages of metal forming equipment built by Williams-White, originator of the bulldozer. Write for illustrated Bulletin #73.

WILLIAMS-WHITE & CO 600 Third Avenue, Moline, Ill.

the measure of Performance Reliability for more than a century



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REN epoxy plastic materials for tooling, fixtures, master model and pattern making can save up to 50% in man-hours and material costs. REN products offer constant batch-to-batch uniformity and high quality . . . in a wide range of formulations to fit application requirements exactly.

REN-Wood model faced with REN-Shape, showing type of construction. (Built by Aero-Detroit Inc., Detroit, Mich.)
REN-Wood
A highly uniform, dimensionally stable, completely carvable plastic material for master model and pattern making. Savings result from 100% usability and defect-free composition.
REN-Shape
A fast-curing, carvable epoxy paste material featuring easy workability and dimensional stability. It provides a fast, accurate method of building and duplicating male and female parts, or as a repair or rebuilding material.
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ren plastics, inc.

lansing 9, michigan

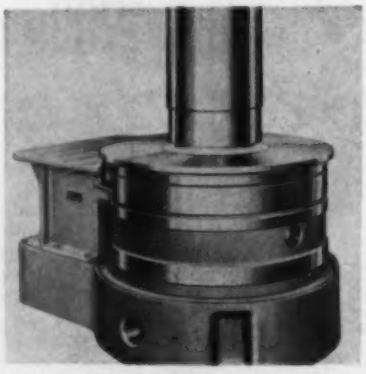
Plasma Cutting Torch Cuts Up to 4-in.-Thick Metals

Flame cutter, utilizing the principle of ultra-high temperature plasma, cuts steel, stainless, aluminum, copper, cast iron; even metals such as tungsten, molybdenum, tantalum apply to this process. Using argon, nitrogen, and hydrogen mixtures, and operating with dc power supplies, the unit fits any standard cutting carriage or pantograph so that the torch is centered with the torch holder.

With plasma velocities over 10,000 mph and temperatures in excess of 50,000 F, cutting speeds are extraordinarily high. Simple, accurate controls for gas mixtures, gas velocities, and electric power permit quick adjustment for metal thickness and for cutting speeds from one to hundreds of inches per minute Typical speeds for mild steel, stainless, and aluminum are 200 ipm with superior quality, dross-free cuts said to result.

Thermal Dynamics Corp, Lebanon, NH

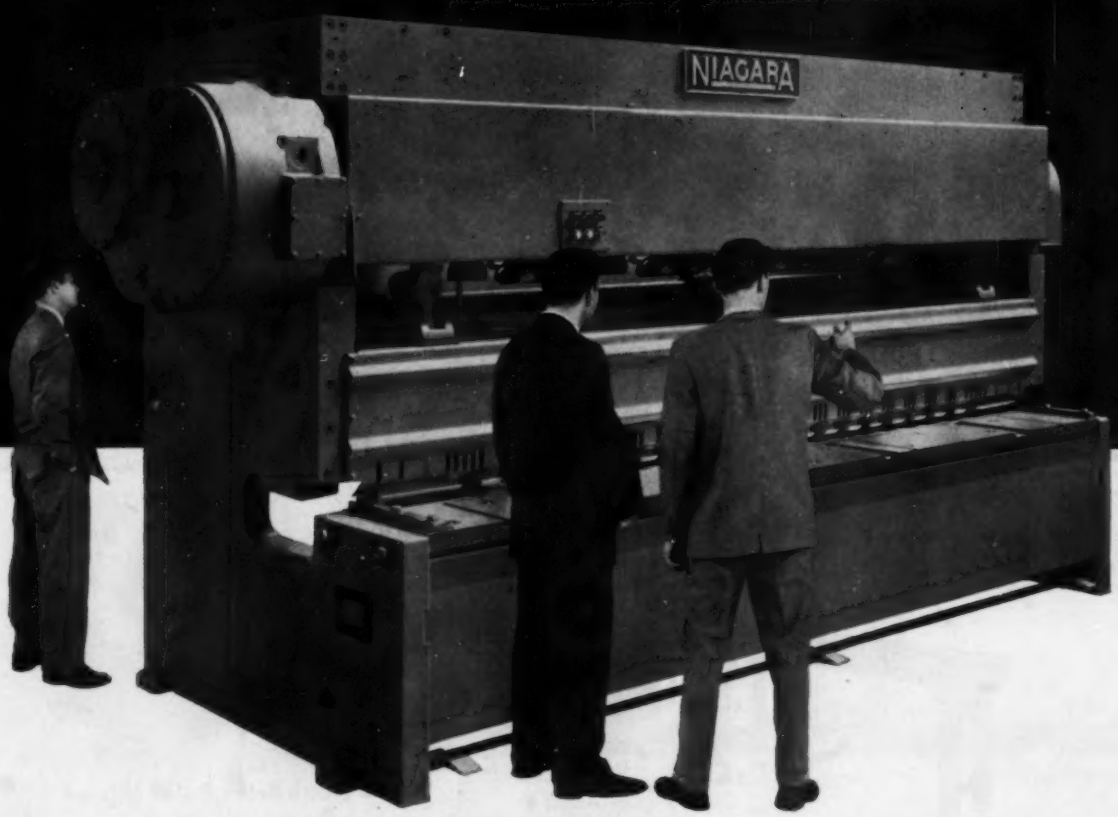
MORE DATA? Circle 113, inside back cover



HEAVY-DUTY TURRET INDEXING machine chassis, with 18-in. dia center post, provides intermittent motion for multiple-station operations and a stationary center column for inboard tool mounting. The standard unit is available with 6 to 32 work stations and a wide variety of indexing speeds — *Swanson-Erie Corp, Erie, Pa*

MORE DATA? Circle 114, inside back cover

MOST TALKED ABOUT SHEARS TODAY!



new gap frame series has quietest holddown in the industry!

Fifty percent (50%) faster than ever before and by far the most accurate of all, new Niagara Gap Frame Shears have a quiet operating holddown that's the talk of the industry.

And no wonder. Holddown feet simply never touch the bed. Yet they apply full pressure . . . a powerful toggle-action grip on thick and thin material alike. Simultaneously, in fact. There's *never* any pounding or hammering of the bed. *Naturally,* it's bound to be quieter!

But, because attention is currently focused on the holddown, don't *you* overlook these other equally important features:

- Massive, closed box section bed forms a rigid backbone for the shear and a solid backing for the knife.
- Rigid, closed triangular section crosshead keeps upper knife in perfect alignment without shims or set screws.
- Combined, total rigidity assures utmost accuracy and square cuts.
- Reduced slope of upper knife produces flatter strips with less twist or curl.
- Front controlled 2-speed power back gage provides extra work clearance at rear of machine.
- New mirror-light gage enables shearing wider sheets to a scribed line.

Now for more facts and figures, request Bulletin 860-S. Write today. NIAGARA MACHINE & TOOL WORKS, 683 Northland Ave., Buffalo 11, N. Y.

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The Most Extensive Line of Shears in the Industry . . . Overdrive and Underdrive . . . Power and Manual

CIRCLE 227 READER SERVICE CARD

There is a WELLS METAL CUTTING BAND SAW tailored to your needs

BIG JOBS . . .

The Wells Model 1200 provides 12" x 16" capacity with automatic cutting cycle at a price that is remarkably low for such high standards of design and quality. Equipped with the Wells Roto-Veyor Bar Feed (shown at right), the Model 1200 becomes a fully automatic heavy-duty cut-off machine. Other Wells models provide capacities of 10" x 16", 8" x 16" and 6" x 13" down to machines for . . .

. . . SMALLER JOBS

Two economy priced convertible Wells models may be used for horizontal cut-off work or as upright saws. Both may be equipped with optional wheels and handles for complete mobility. The Model 58-B offers 6" x 10" capacity, the Model 300 (shown at right) provides 3½" x 6" capacity.

With six quality-built models to choose from, there is a Wells Saw that will fit your needs and your budget. Call your Wells distributor or write for descriptive literature.

61-3

Wells

SAW SPECIALISTS SINCE 1925

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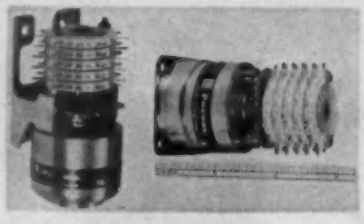


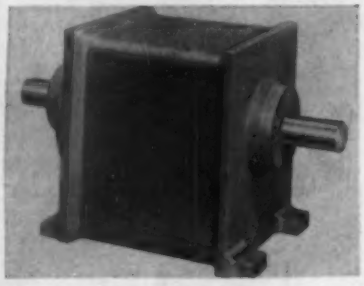
Solenoid-Switch Package Measures 1⅝ in. in Length

Drive package, a Pacsol D size rotary solenoid and its closely coupled detent mechanism, measures 1⅝ in. in length. Each wafer switch stacked on the output shaft adds only 11/64 in to the unit's total length. It will pull up to 10 wafers at 60-w input or less.

The entire package may be fitted in a 1½-in.-dia tube after wiring. Alternate mounting brackets permit either horizontal or vertical positioning of the unit for further space saving. Standard Pacsol D size solenoid steps 360° in 30° increments and is single-pulse operated. Self-interrupter and homing switches are also available.

Illinois Tool Works, Iicon Div, 6606 W Dakin St, Chicago, Ill

MORE DATA? Circle 115, inside back cover



Clutch-Brake Drives Offered For 1200-rpm Operation

Drives for use on all types of machines, special machinery, and automation equipment are available in six different sizes furnished as either foot or flange-mounted units. Clutch can be actuated by any type of 3-way pneumatic or hydraulic valve. Brake is spring operated and automatically released by mechanical interlocking with the clutch.

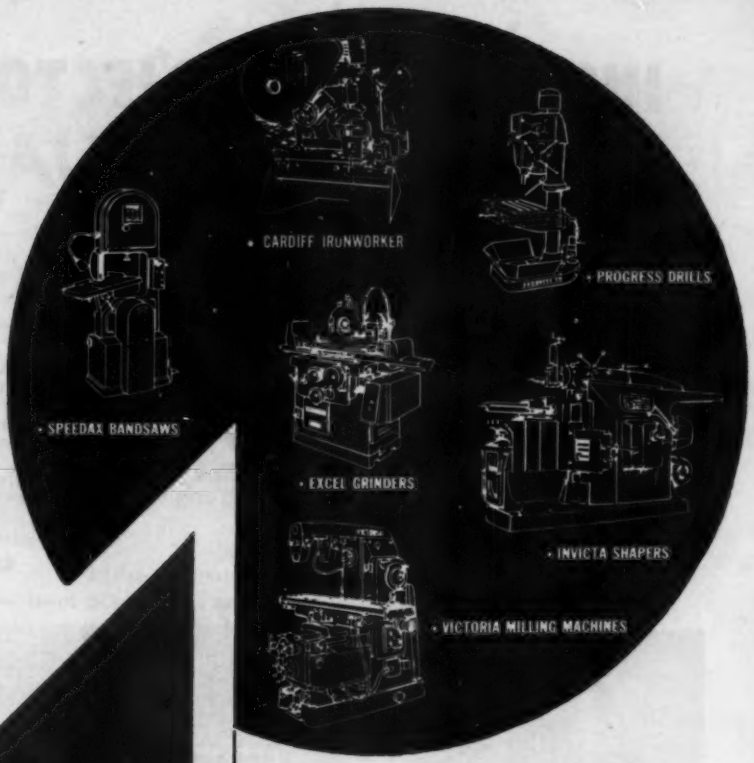
Only four screws are required for mounting. A sheave, flywheel, sprocket, or coupling can be mounted directly on the input shaft, and a gear, sprocket, cam, eccentric, or coupling can be mounted directly on the output shaft.

Sommer Associates, 326 N Western Ave, Chicago, Ill

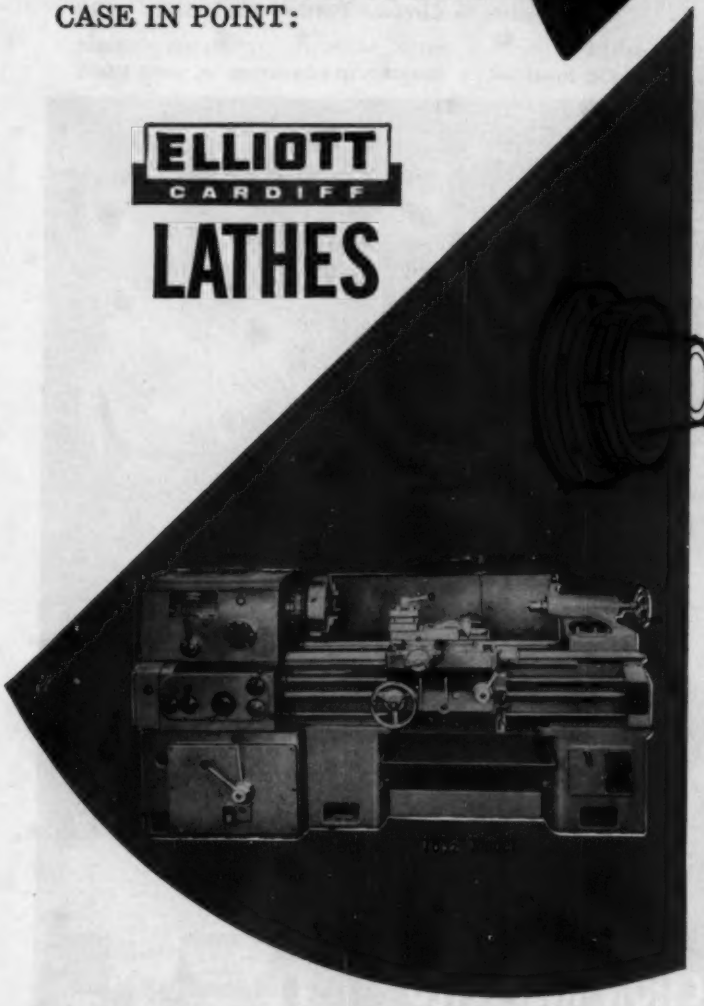
MORE DATA? Circle 116, inside back cover

ELLIOTT MACHINE TOOL BUILDERS

A COMPLETE PROGRAM FOR YOUR SPECIALIZED NEEDS! CASE IN POINT:



ELLIOTT CARDIFF LATHES



A wide range for heavy duty, tool-room precision and fast production

13″ to 22″ models

Exclusive features—designed to reduce production costs, increase safety, speed and dependability:

3⅛″ hollow spindle, big hole-through capacity

- the most modern up-to-date design
- flame hardened and ground bed
- totally enclosed versatile feed box
- 120 feed changes without change wheels
- double-walled apron
- hardened ground gears and spindle
- heavyweight rugged castings

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MACHINE TOOLS Manufacturers (a division of the world's foremost machine tools manufacturers) fulfills the demand for quality MACHINE TOOLS and competitive pricing "backed" by all the advantages of domestic machine tools: ■ Factory Distribution and Service ■ Controlled Dealer Franchises ■ Frequent Personal Contact with our Executives ■ Full Inventory of Spare Parts ■ Factory Service Engineers ■ Factory Technical Service HOME OFFICE AND PLANT: Port Hope, Ontario/LOS ANGELES, CAL.: 1128 Crenshaw Blvd./BOSTON, MASS.: 19 Brook Street, Needham Heights, 94/ CHICAGO, ILL.: 518 Main Street, Evanston

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Our inspection projector magnifies cutting edges to eliminate the minute angular deflection that could cause you costly production losses . . . just one of many inspections that account for Circle R quality.

CIRCLE R saws, slitters and combination center drills must submit to constant exhaustive inspection to work their way to you. They've got to prove they can ensure you correct cutting angles, long service, and minimal downtime.

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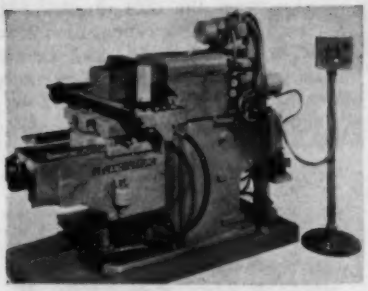


Knee-Type Gun Drill Comes With Hydraulic or Lead Screw Feed

This knee-type gun drill, No. 24C, is designed to drill deep precision holes in ferrous and non-ferrous materials. Using carbide tipped drills, the drilling unit comes with either a self-contained hydraulic feed or a lead screw feed.

The self-contained hydraulic feed unit, recommended for drilling holes up to ⅝-in. dia by 7-in. deep, is said to have a highly uniform feed rate with simple feed rate changing. Pump and spindle are independently powered by a 1½-hp motor through a timing belt drive. For general use, variable speed drives are available up to 10,000 rpm.

The lead screw feed electro-mechanical unit is designed for holes having a depth greater than 7-in. It can be furnished with a 12, 24, or 36-in. stroke. Driven by a 1½-hp motor through a non-slip timing belt, the spindle can be run at speeds from 720 to 12,000 rpm with a 3,600 rpm motor, or at 360 to 6,000 rpm with an 1,800 rpm motor. Pick-off gears actuate and synchronize feed to spindle speed from a minimum of .00019-in. per revolution to a maximum of .0015-in. in increments of .000015-in.

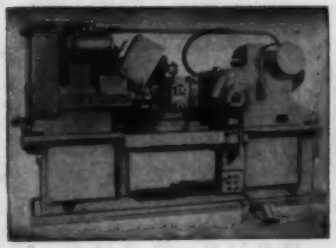
Leland-Gifford Co, Worcester 1, Mass

MORE DATA? Circle 117, inside back cover

DESOUTTER PNEUMATIC NIBBLERS have capacity of 0.064 in. in steel, weigh 3 lb, cut at rate of 6 fpm, have turning radius of 1 in. A 7/32-in.-wide cut is attainable without burring or deforming the sheet and the tool will cut to within ⅜ in. of a templet—*Newage Industries Inc, 222 Old York Rd, Jenkintown, Pa*

MORE DATA? Circle 118, inside back cover

Here's what is meant by "1·2·3" in the GOSS & DeLEEUW AUTOMATIC CHUCKING MACHINE



The outstanding advantage of this machine is ability to handle operations on one, two or three ends of a piece *simultaneously or in sequence, without changing set-up or rehandling.* It is the only standard machine that will do this.

"1-2-3" means ability to handle work requiring machining operations on one, two or three ends simultaneously or in sequence—a method exclusive with Goss & DeLeeuw and offered on this machine.

For complete details ask for illustrated bulletin. Send samples of your work for time and cost estimates.

GOSS & DeLEEUW QUALITY PRODUCT-QUANTITY

GOSS and DE LEEUW MACHINE COMPANY. KENSINGTON. CONN.. U.S.A.

Partial List of customers who have bought ONSRUD again and again

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Beech Aircraft Corp.
Bendix Aviation Corp.
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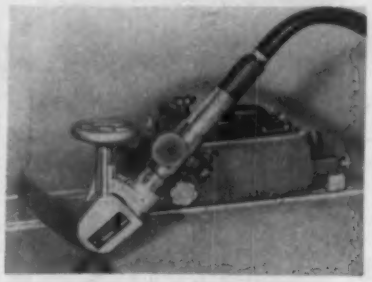
Boeing Airplane Co.
Borg-Warner Corp.
Cadillac Tank Div. (GMC)
Convair Astronautics Div.
General Dynamics Corp.
Douglas Aircraft Co., Inc.
General Electric Co.
Hotpoint Division
General Electric Co.
Kiekhaefer Mfg. Corp.
Lockheed Aircraft Corp.
Lone Star Boat Co.
McDonnell Aircraft Corp.
National Cash Register Co., The
North American Aviation Inc.
Northrop Aircraft Inc.
Raytheon Mfg. Co.
Reynolds Metals Co.
Rohr Aircraft Corp.
G. D. Roper Co.
Rostad Aluminum Corp.
Sunbeam Corporation
Westinghouse Electric Corp.
Whirlpool-Seeger Corp.

ONSRUD can do a lot for you

DOING THINGS *better* BY DOING THINGS *differently*

ONSRUD
MACHINE WORKS, INC.
7720 LEHIGH AVENUE
NILES 48, ILLINOIS
(A SUBURB OF CHICAGO)



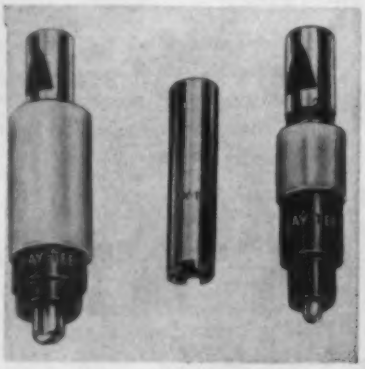
Automatic Travel Torch Speeds Plate Edge Preparation

Model T-5 semi-automatic torch, designed for gouging for weld preparation, de-seaming, and similar operations, is reported to produce smooth machine-like groove or bevel in heavy plate. Straight, fast cuts can be produced in stainless steel and other special alloy plates. By square butting two plates and gouging along the seam, a smooth ,uniform U groove is produced, preparing the edge of both plates with a single operation.

The torch, which can be mounted on a standard cutting machine, is provided with a 32-pitch rack. Operator feeds the carbon-graphite electrodes by means of a handwheel, and can easily control the desired groove or gouge. The T-5 uses electrodes ranging from ¼ to ⅝ in.

Arcair Co, PO Box 431, Lancaster, Ohio

MORE DATA? Circle 119, inside back cover



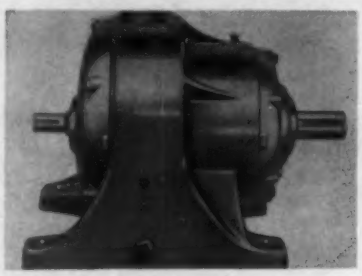
Line of Staking Tools Includes One New Type, Wider Size Range

Two types of this line of standardized staking tools now incorporate a built-in pilot pin, made slightly oversize, so that it can be turned down to exactly fit the inside diameter of the work. Type 1 is now available in 10 sizes from 0.265 to 0.406-in. dia, and Type 2 ranges from 0.125 to 0.250 in.

Both of the types, which are offered, in 1/64-in. increments, give nearly twice the size range of the earlier line. A new type, called Model JTM, comes in 19 sizes ranging from 0.125 to 0.406 in 1/64-in. increments.

Jay-Tee Mfg Co. 1515 N 25th Ave, Melrose Park, Ill

MORE DATA? Circle 120, inside back cover



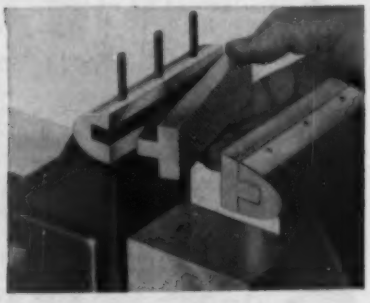
Syncrogear Speed Reducers Have Improved Gear Arrangement

Double reduction units incorporate improved gear arrangement for low speed, high torque, extra capacity working performance. Reducers are provided in two types of gear train construction, depending on the rating of the unit: Type GDO, with normal double reduction gear train, and Type GLO, also double reduction, but with a duplex arrangement.

Particularly suited for applications with space limitations, Type GLO uses two primary gears and two final pinions to share the load from high speed pinion to slow speed output gear. These units are designed to be driven by a separate, direct-connected motor.

US Electrical Motors Inc, Box 2058 Terminal Annex, Los Angeles, 54, Calif

MORE DATA? Circle 121, inside back cover



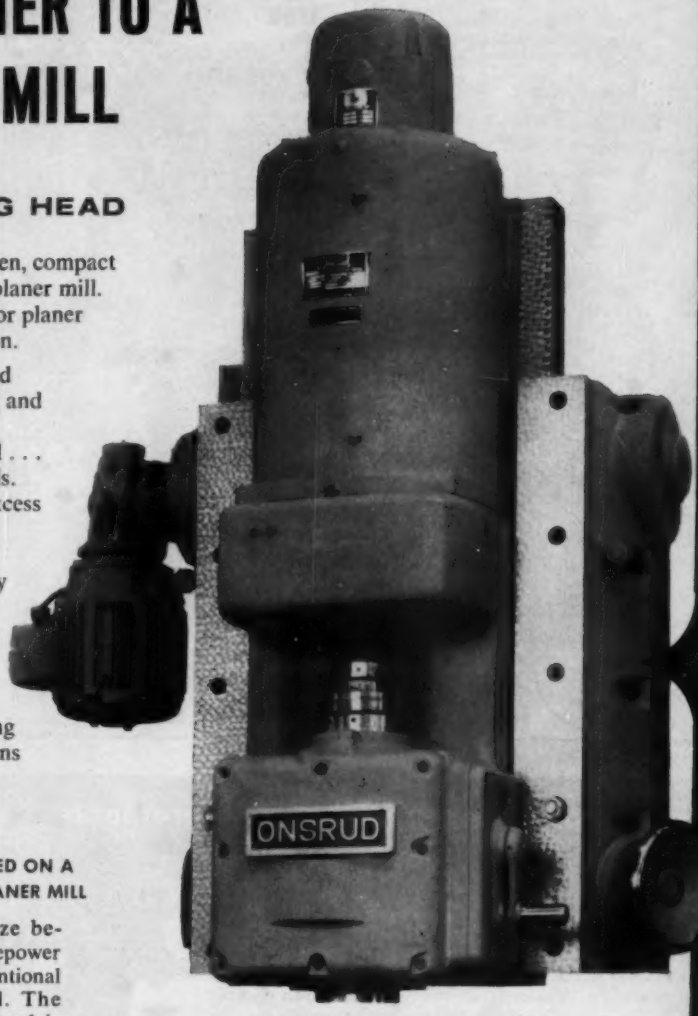
REPLACEABLE T JAW FACES, made of hardened tool steel, are a feature of a new line of machinist vises. Faces are anchored in malleable iron jaws. Entire jaw face area is covered by a solid gripping surface—*Columbian Vise & Mfg Co, 9023 Bessemer Ave, Cleveland 4, Ohio*

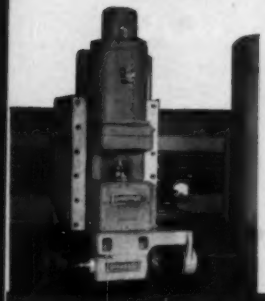
MORE DATA? Circle 122, inside back cover

Now . . . CONVERT YOUR PLANER MILL OR PLANER TO A MODERN PLANER MILL

. . . with the NEW ONSRUD MH-50 MILLING HEAD

- With this 24 speed, 50 H.P., gear driven, compact milling head you can have a modern planer mill. Since the Head is compact it is ideal for planer conversion or new machine installation.
- The NEW ONSRUD Planer-Mill Head has speed ranges for both aluminum and steel . . . 12½ to 1250 rpm or 18 to 1800 rpm. It is compact and powerful . . . 54" o.a. . . . 50 H.P. . . . 2040 pounds. Metal removal rate on mild steel in excess of one cubic inch per H.P. The drive motor is liquid cooled and therefore capable of continuous heavy duty operation.
- The ONSRUD Milling Head has a unique gear train with 24 dial speeds as shown in table below.
- Send for Catalog No. 1178, containing complete descriptive data, specifications and dimensions.





THE ONSRUD MH-50 MILLING HEAD MOUNTED ON A MODERN 72" X 18" PLANER MILL

Note comparative size between Onsrud 50 horsepower spindle head and conventional 20 horsepower head. The ONSRUD Milling Head is available with or without a right angle milling attachment.

Onsrud MH-50 Series Spindle Head . . . POWER and SPEED RANGE THROUGH LEVER CONTROLLED GEAR TRAIN

MODEL NO.	HORSEPOWER RATING *	AVAILABLE SPINDLE SPEEDS IN RPM THROUGH GEAR TRAIN																							
		12½	15	18	23	25	31	38	46	57	70	87	105	130	160	196	240	296	364	446	548	675	825	1020	1250
MH-50-12	25-50	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
MH-50-25	50					o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
		18	22	27	33	36	44	54	66	82	101	127	151	186	226	281	341	421	526	654	791	967	1183	1473	1783
MH-50-18	25-50	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
MH-50-36	50					o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

*ALL ONSRUD MOTORS WILL DELIVER 1HP PER RPM UP TO MAXIMUM RATED HORSEPOWER . . . AND AFTER THIS LEVEL, WILL DELIVER CONSTANT RATED HORSEPOWER.

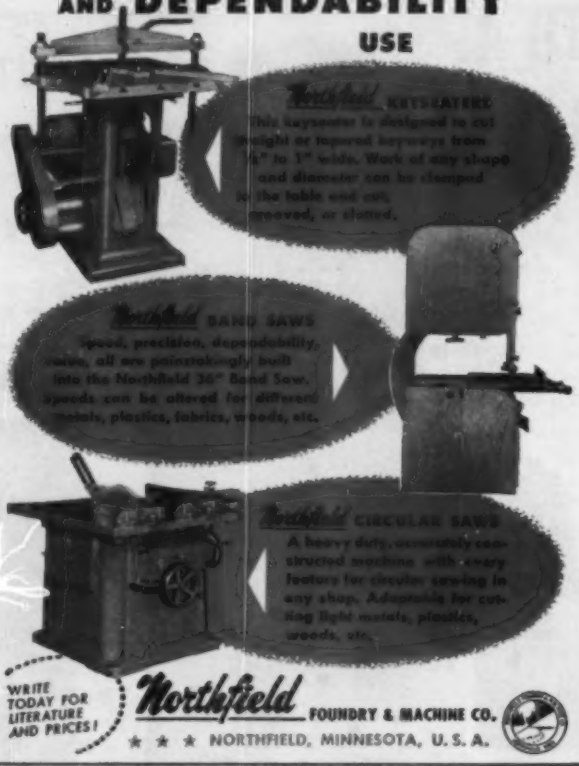
ONSRUD

ONSRUD MACHINE WORKS, INC. 7720 LEHIGH AVE. NILES 48, ILL. *(SUBURB OF CHICAGO)*

CIRCLE 233 READER SERVICE CARD

ONSRUD ANNOUNCES

FOR EFFICIENCY AND DEPENDABILITY USE



Northfield KEYSEATER
This keyseater is designed to cut straight or tapered keyways from ¼" to 1" wide. Work of any shape and diameter can be clamped to the table and cut, grooved, or slotted.

Northfield BAND SAWS
Speed, precision, dependability, value, all are painstakingly built into the Northfield 36" Band Saw. Speeds can be altered for different metals, plastics, fabrics, woods, etc.

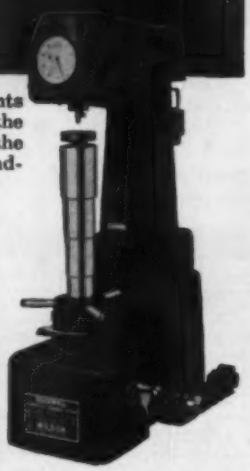
Northfield CIRCULAR SAWS
A heavy duty, accurately constructed machine with every feature for circular sawing in any shop. Adaptable for cutting light metals, plastics, woods, etc.

WRITE TODAY FOR LITERATURE AND PRICES!

Northfield FOUNDRY & MACHINE CO.
★ ★ ★ NORTHFIELD, MINNESOTA, U. S. A.

CIRCLE 234 READER SERVICE CARD

Easy Operation, Precision Measurements ...with Wilson "Rockwell" Hardness Testers



No matter what your hardness testing requirements are, there's a Wilson Rockwell instrument to do the job easily and accurately. Wilson instruments on the production line and in the laboratory offer these advantages:

Accuracy—Precision-built, with exact calibration, for consistently correct results.

Easy operation—Even an unskilled operator can get perfect readings. All controls conveniently grouped.

Long life—Simple design, rugged construction make Wilson instruments as durable as a machine tool.

Easy maintenance—Interchangeable mechanisms, with spindles mounted in oil-less bearings.

Complete line—Choose from the widest variety of instruments available, including semi and fully automatic models and Wilson "Brale" diamond penetrators.

Write for details—Ask for Catalog RT-58. It gives complete information on the full line of Wilson Rockwell hardness testers and accessories.

WILSON "ROCKWELL" HARDNESS TESTERS

Wilson Mechanical Instrument Division
American Chain & Cable Company, Inc.
230-B Park Avenue, New York 17, New York

ACCO

Mechanical Power Amplifier Offers Higher HP Ratings

No. 13TAA0024, designed for applications requiring higher horsepower ratings to move heavy loads, is said to provide up to 2½ times greater torque output over previous units and will amplify the 1/30-hp output of a low-powered two-phase servo motor to deliver and control up to 4 hp.

Model provides continuous power over a 50-1 speed range with greater ranges available for special applications and will amplify torque from any control input device. It is said to have excellent dynamic response, permitting the design of high-sensitivity control systems. Torque amplification is supplied by an easily replaceable part which operates on the windlass principle. This part amplifies the output of a servo motor in such a way that the mechanical power amplifier functions as a high-powered servo motor.

Seneca Falls Machine Co, Fyfe Bldg, Seneca Falls, NY

MORE DATA? Circle 123, inside back cover

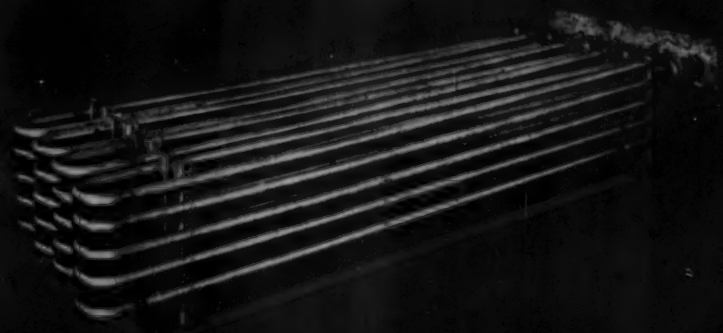
Double Passage Rotating Union Introduced by Deublin

Model 1595 is rated at 150 psi air pressure, 1000 psi hydraulic oil pressure with rotational shaft speeds up to 200 rpm. This slow speed union is recommended for such equipment as material handling or for any device which utilizes air or hydraulic cylinders or clutches that either rotate or oscillate. In addition, it is applicable to rotating cylinders that require pressure to either side of a piston. Designs which require two air clutches on the same shaft with the entrance from only one end is another place for this type union.

Deublin Co, 1919 Stanley St, Northbrook, Ill

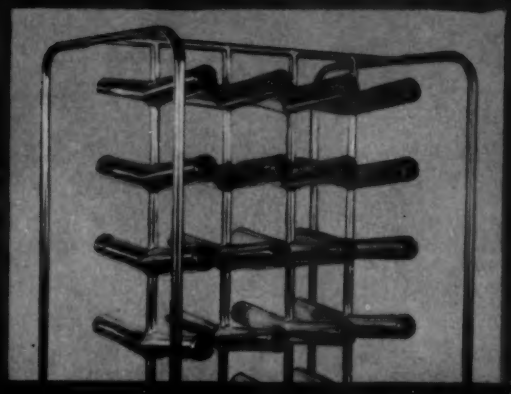
MORE DATA? Circle 124, inside back cover

you can bend it...



you can form it...

you can weld it...



but you can never, no never, change its **consistent uniformity!**

...no matter what test you put it to, you'll get consistent performance, greater output, better quality and more profit with Carpenter Specialty Stainless,...produced by one of the leaders of stainless steels for industry.

Carpenter steel

you can do it ***consistently*** better with Carpenter Stainless Steels for specialists

The Carpenter Steel Company, Main Office and Mills, Reading, Pa.
Alloy Tube Division, Union, N. J.
Webb Wire Division, New Brunswick, N. J.
Carpenter Steel of New England, Inc., Bridgeport, Conn.

CIRCLE 236 READER SERVICE CARD

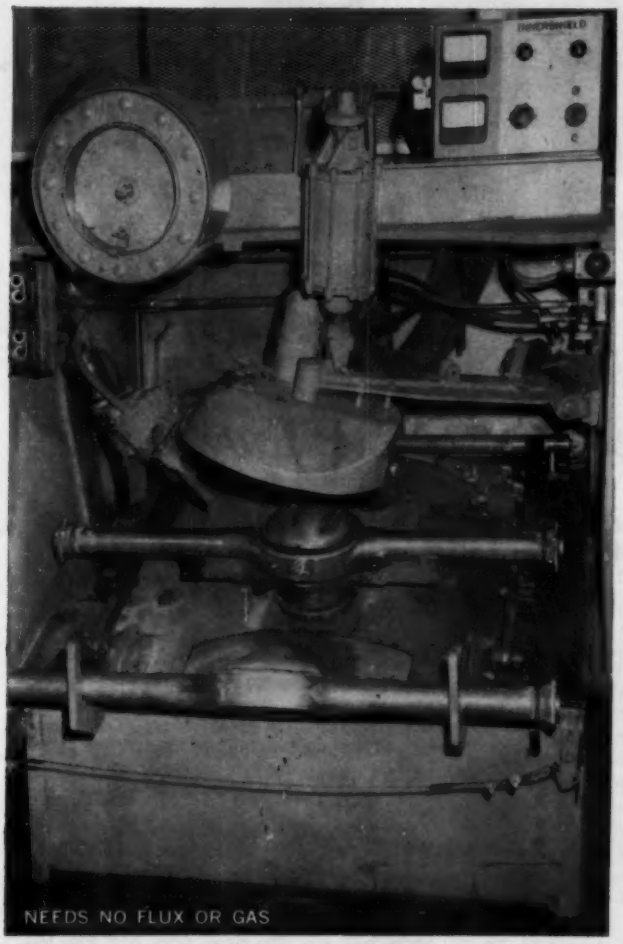
It's what's inside that counts

NEW TUBULAR ELECTRODE

Now quality automatic welds can be made without CO_2, Argon or granular flux. Photo magnifies electrode 3½ times.

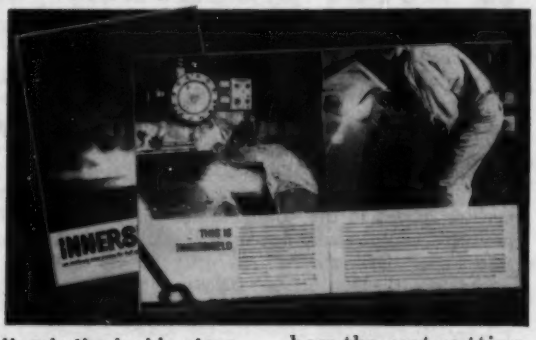
NEEDS NO FLUX OR GAS

LINCOLN'S dramatic new welding process—INNERSHIELD—uses a special tubular electrode containing all necessary ingredients—filler metal, arc shielding, deoxidizers, fluxes. Two new welders use it—a full automatic and a semi-automatic.



This is Lincoln's Innershield at work . . . full-automatic. No other automatic process even comes close to the speed. You press the button to weld and really lay down a bead fast . . . over 300 inches per minute on light gage lap or butt welds. The dust cap and flanges of this axle housing demonstrate how Innershield really goes to work—they are welded 60% faster with Innershield than with the previous process.

This is Lincoln's Innershield Squirt . . . on the job. It's ideal for high-speed, single-pass welding on light metal parts like these building trusses. Deposition efficiency is high, since the electrode is a continuous 50-pound coil. In this operation, Innershield increased welding speed 30%. That's not all: because this automatic electrode contains *ALL* the welding ingredients, purchasing, inventory and storage are simplified.



Here's the inside story . . . how the cost-cutting, profit-producing advantages of Innershield can go to work for you. A new bulletin, hot off the press, covers the dramatic story of the new tubular electrode and how it works. It also describes in detail both the full and semi-automatic Innershield welders now available. Write for your copy of bulletin 5300.1 today. The Lincoln Electric Company Dept. 1621, Cleveland 17, Ohio.

LINCOLN WELDERS

THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT AND ELECTRODES

Announcing
CARMET®

700

Series Cutting Grades

to boost production–extend tool life up to 200%

If you're tooling-up for a really tough cut, try Carmet's new 700 Series Cutting Grades. Make one super-duty tool do the work of two or three—on any steelcutting job, including superalloys.

Carmet's 700 Series is a new, premium group of carbide grades just released after exhaustive field trials. Results were conclusive. These carbides stood up under the roughest interrupted cuts going. They gave longer tool life than competitive grades in the same application class. And, they produced exceptionally fine finish cuts, even in C-8 precision boring classifications.

Here are the 700 Series Steelcutting Grades, and their applications:

CA-704 Hard and dense for the ultimate in finish cuts and precision boring.

CA-711 Ideal for medium to finish cuts in the general purpose category.

CA-720 Tough and thermal shock-resistant for medium and heavy cuts, including interrupted cuts.

These new Carmet Grades combine edge wear and crater resistance with an unmatched ability to endure shock. The 700 Series will outperform other groups of tools in any C-5 to C-8 application. Take a look at a few customer trial reports:

"Turning tapered, slotted, forged SAE 4140 valve plugs . . . formerly got 8 finished pieces per cutting edge. Now get up to 25 pieces with CA-720 on a tough, interrupted cut!"

"Turning OD of universal joint ears . . . now getting 177 pieces with CA-720 against 135 with former tool."

"On SAE 1035 rotor shafts . . . got 7 more shafts per tool with CA-711. And K Monel shafts . . . got more from 9 CA-711 tool corners than 12 corners on triangular inserts formerly used."

"On SAE 4320 forgings . . . a whopping 242 pieces with CA-720, against 209 with previous Carmet 600 Grade, 198 with best competing tool."

Remember, for less demanding operations, the 600 Series Cutting Tools will continue to be sold by Carmet. But for the really tough cut . . . when you've got to make chips on a mean, tool-buster of a job . . . this kind of performance from the 700 Series will save you time. And, cost you less than competing premium grades!

They're doing just that in shops all over the country . . . right now! Try them, just once, on your job. Your local Carmet Distributor has them in stock. Contact him for more information, or write: ***Carmet Division, Allegheny Ludlum Steel Corporation, Ferndale, Detroit 20, Michigan. Dept. AM-3.***

CARMET CATALOG SUPPLEMENT NOW AVAILABLE

There's a new Supplement to the Carmet Catalog C-16-B, listing tool and insert styles, and prices for the new 700 Series. Contact your local distributor, or write Carmet direct.

2000

CARMET® AL

CEMENTED CARBIDE • DIVISION OF ALLEGHENY LUDLUM

Pushbutton Mixmaster Speeds Grinding-Wheel Production

Bay State Abrasive Products Co has just put into operation an electronic "pushbutton mixmaster" that automatically measures and mixes all the ingredients for grinding wheels.

In the system, a punched card containing a customer's grinding-wheel formula is inserted in the mixmaster. At once, electronic impulses in the machine send instructions to huge storage bins above the machine. Each of the specified ingredients then feeds down by gravity through a system of pipes to a container in which the order is prepared.

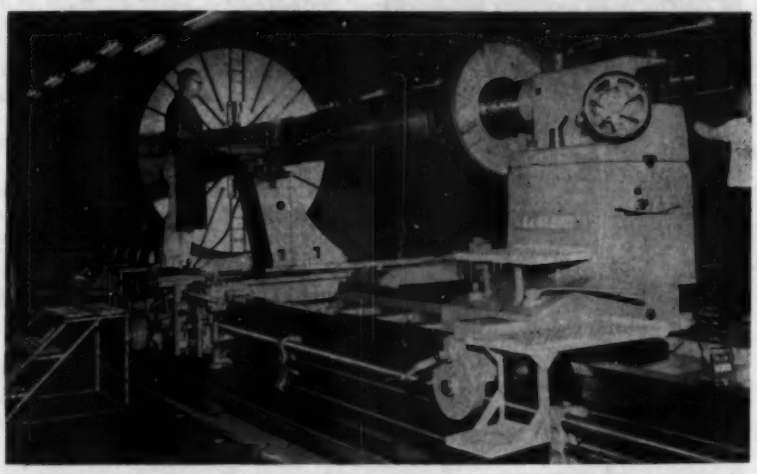
The system is built to handle sixty different abrasive grits. Weighing of ingredients is reported accurate to within one millionth of a pound.

Van Norman Acquires Rights To Make, Sell, New Machine Tool

Van Norman Industries has acquired manufacturing and sales rights to a new multi-purpose drilling and tapping machine. Formerly known as the Magna Drill, it'll be marketed under the name of Versi-Matic and will be produced and sold through the Van Norman Machine Co, division of VNI in Springfield, Mass.

Garrett Gets $18 Million In Orders for F-104

Garrett Corp, Los Angeles, has received initial contracts totaling $18 million for environmental equipment and central air data systems to be installed on versions of the Lockheed F-104 Starfighter ordered by Germany, Belgium, the Netherlands, Canada, Japan, and Italy. In view of Garrett being named approved vendor for environmental equipment and air data systems for various versions of the F-104, the company could realize total sales of approximately $64 million, based on the approximately 1600 Starfighters on order.



Largest precision lathe ever delivered to the Southwest is installed in Chance Vought Corp's Aeronautics Division. Machine, developed by R K LeBlond to Vought's specifications, is capable of turning and tracing material as large as 86 in. in diameter and 312 in. in length. Work measuring up to 100 in. in diameter may be faced or bored and material weighing up to 34 tons can be supported between centers without a steadyrest. For materials exceeding this weight, a giant steadyrest 10 ft high and weighing 7400 lb is provided

Stromberg-Carlson Division Changing Name

Stromberg-Carlson Division of General Dynamics Corp will lose its identity in a reorganization move confirmed by the parent firm. The change will have no effect on present operations in Rochester, NY, according to company spokesman, although there are rumors that the division's headquarters will be moved to Los Angeles.

The Stromberg-Carlson tradename will continue on telephone equipment and commercial and consumer sound systems. All other products of the new division will carry the General Dynamics/Electronics label to give the company a stronger electronics identity.

AMF Completes Big Expansion At Brazilian Subsidiary

American Machine & Foundry has just completed a $1 million program at AMF do Brasil SA in Sao Paulo. The local firm has been manufacturing automatic cigarette-making and packaging machines since 1956 and now plans to produce equipment for the Brazilian petroleum and auto industries. Its machines for the tobacco industry are 95% built from local materials. Company employs 300 at its enlarged plant which covers 6000 sq yd and can be enlarged an additional 4000.

Electric Autolite Closing Plant

Employees of the Sharonville, Ohio, bumper plant have been told that manufacturing there would be discontinued with the completion of production for the 1961 car models.

McGIRK'S WORKS
by GEO. CRENSHAW
I THINK MONK IS STARTING TO DRINK ON THE JOB.
THAT'S A PRETTY SERIOUS INSINUATION. WHAT MAKES YOU THINK SO?
OH, I DUNNO... JUST KIND OF A SNEAKING SUSPICION I HAVE.
GATE A
MOE'S CORNER
Personally, I drink TO FORGET...
...the hangover I'm gonna have later!!

These 6 finely finished surfaces required only 3! operations or just 1/2 operation per end

How do you do jobs like this in your shop now?

And in the process the metal was also severed or CUT AT THE SAME TIME.

24 seconds to cut the 2 squares
20 seconds to cut the 2 tubes
12 seconds to cut the 2 angles

OR less than one minute for the whole job — Cut 3 pieces! And also finish 6 ends at the same time.

Can you afford not to investigate?

Write or phone COLLECT to Klaus von Frantzius. Ask for information about "Cut-Machining."

WALLACE
SUPPLIES MFG. COMPANY
3510 N. Ravenswood Ave. • Chicago 13, Illinois

FIELD REPORT

The nearly 300 hourly and salaried workers have been informed of the decision five to six months ahead of the shutdown and the company is preparing a program to assist the employees in individual relocation efforts.

At peak production the plant employeed some 700 but the trend of car makers to produce more of their own parts has had an increasing effect on the volume of the plant.

Bohn Expanding Michigan Plant

Bohn Aluminum & Brass Corp, Detroit, plans to expand its facilities at its Adrian plant for production of brass rods and shapes, and aluminum and brass forgings. New manufacturing equipment will be acquired. Transfer of this manufacturing operation from a pre-WW I plant in Hamtramck will be completed during the third quarter of '61.

Machine Tools in the South

The Atlanta Field Office of the US Dept of Commerce has issued a report stating that the machine tool manufacturing outlook for the South for 1961 is "somewhat encouraging, notwithstanding current unsettled economic conditions and the export-import picture.

Shipments of cutting and forming type tools are expected to continue in the first half of 1961 to approximate the level of the last half of 1960, an upturn of both shipments and new orders being anticipated in the second half of 1961."

Waukesha Bearings Corp . . .

. . . has purchased controlling interest in a leading South Carolina metalworking company, Turbo Industries Inc, Batesburg. Waukesha, manufacturer of bearings for medium and large size power equipment, will transfer production of medium size units to Turbo.

Crane Sells Division To Glidden

Crane Co has sold its Powdered Metals Division at Johnstown, Pa, to the Glidden Co of Cleveland. The powdered metals plant was inherited a year ago when Crane purchased assets of National-US Radiator Co. Powdered metals production and sales do not fit Crane's other operations, according to Chairman T M Evans, so sale is a logical one from Crane's standpoint.

FM&C Sets Up Japanese Division

Food Machinery & Chemical Corp, San Jose, Calif, has established a Japanese manufacturing division, Food Machinery (Japan) Ltd. The new facility will produce food canning, processing, and packaging machinery, fresh produce packing equipment, and related products under an extensive license agreement. The division has been set up in connection with Toyo Seikan Kaisha Ltd, a leading Japanese can manufacturer.

Hiller Aircraft Corp . . .

. . . Palo Alto, Calif, has entered into a contract with two other aircraft firms to submit proposals to the Navy Bureau of Weapons for a new Tri-Service VTOL. The Bureau called for design proposals Feb. 1. Chance Vought, Dallas, will be prime contractor for the project and Ryan Aeronautical Co, San Diego, will be associate contractor along with Hiller

Chevrolet Expands in Calif

Plans for expansion of the Van Nuys plant include a 76,800 sq-ft addition to the facility. Purpose of the expansion is to enlarge the manufacturing area for full-size cars for nearly all the western states. The Oakland plant is now totally converted to Corvair compacts and trucks.

New Division for Kold-Lube

Precision Metal Processing Co has just been incorporated as a division of Kold-Lube Coaters Inc, Cleveland. The new division plans to offer complete metal processing facilities for manufacturers, die makers, fabricators and metal stampers, and will be headquartered in a 50,000-sq-ft plant in Cleveland.

(Continued on p 147)

"Holy smoke, I'm glad I'm not in business for myself."

ELIMINATE UNNECESSARY ASSEMBLY COSTS with

Replace improvised units with readily available precision cam followers.

McGILL®

CAMROL® BEARINGS

CF (Cam Follower) SERIES

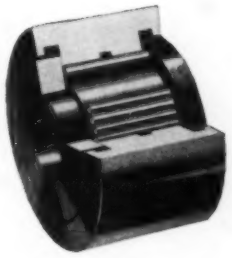
The original and still unsurpassed anti-friction roller bearing cam-follower bearing that adds efficiency at less cost to cam actuated, track and support roller applications. Built with full roller complement and integral stud, the CF series design provides high radial capacity and shock load protection in a compact roller with its own shaft. Easily applied and available in roller diameters of ½" to 4".

for the ultimate in:

- RADIAL CAPACITY
- SHOCK RESISTANCE
- SPACE ECONOMY

SCF SERIES.

Sealed to keep contamination out and lubricant in. It is dimensionally interchangeable with the CF bearings. A turned groove in the center of the outer raceway bore provides a permanent lubricant reservoir to approach life-time lubrication requirements. Can be easily re-lubricated.



SCYR SERIES (sealed)

CYR (Cam Yoke Roller) SERIES

The CYR series increases the adaptability of the CF bearing to all types of automatic machinery involving cam action or controlled-motion machine parts that require guide or support rollers. An inner ring replaces the stud for cam yoke roller mountings.

Write for Catalog No. 52-A for full information on McGill's needle roller bearings, and cam followers. Ask about recommendations for high precision special ball and roller bearings.

SCYR SERIES

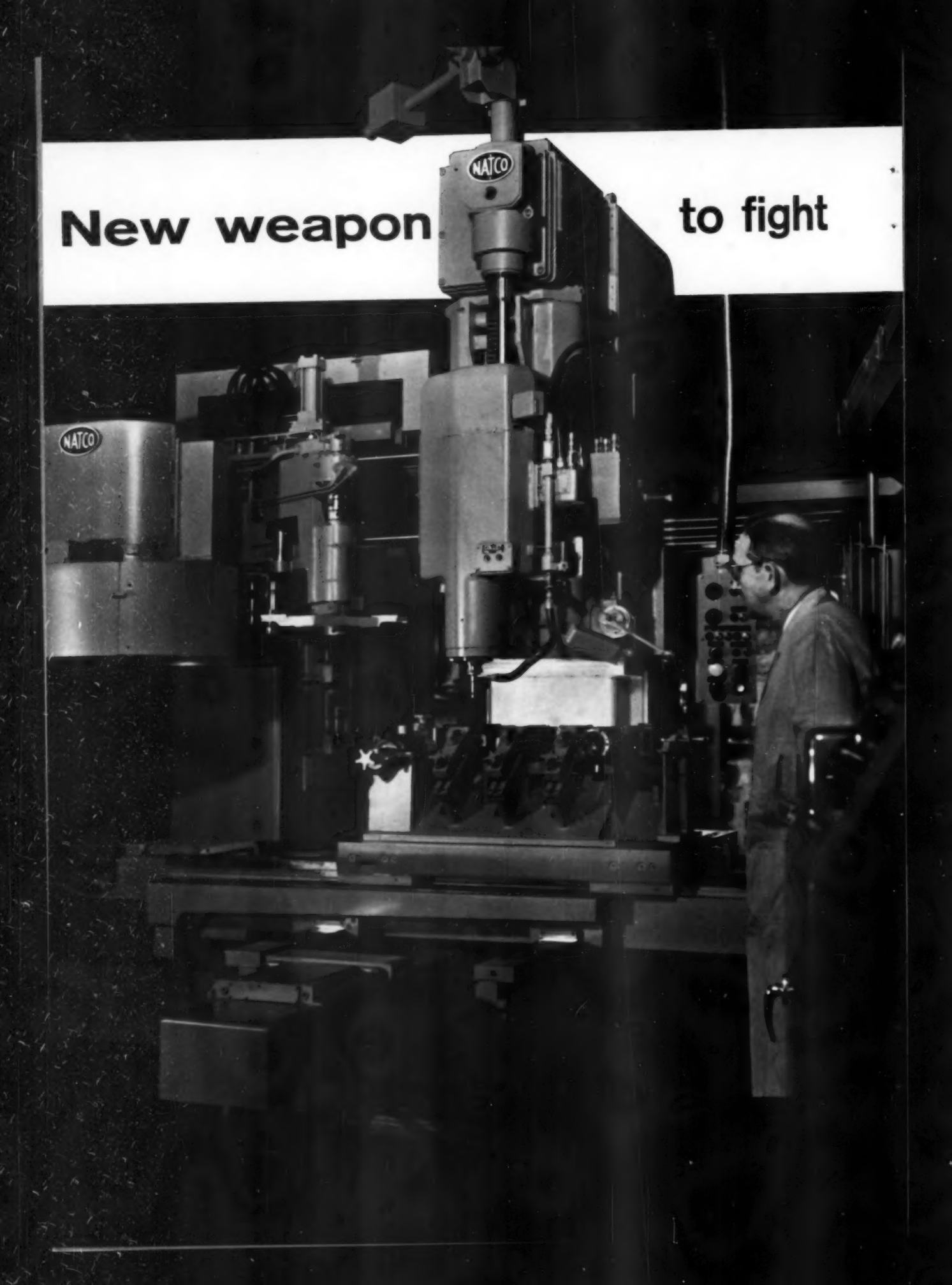
This series provides a fully sealed Cam Yoke Roller type bearing. It is dimensionally interchangeable with the CYR bearings.

McGILL MANUFACTURING CO., INC., Bearing Division
300 N. Lafayette Street, Valparaiso, Indiana

engineered electrical products

McGILL®

precision needle roller bearings


New weapon
to fight
NATCO
NATCO

profit squeeze

Start profits on the upswing by wringing the water out of drilling, tapping, and milling costs. This new Natco Drilling-Tapping-Milling Machine—with Automatic Tool Changing and Natcotrol—is just the machine to do it.

Virtually eliminate jigs and fixtures, chop parts inventory, hold lead time to hours instead of weeks, cut your scrap rate to the vanishing point, know your costs in advance—these are the kind of savings available to you through Natcotrol—Natco's own fully electro-mechanical numerical control system.

Time wasted at the tool crib? Not any more with Natco's automatic tool changer that works without tool coding, and always holds the next tool ready for quick changing.

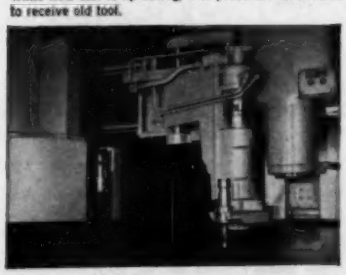
More reasons for putting Natcotrol and the Natco Automatic Tool Changer to work with Natco's powerful new Drilling-Tapping-Milling Machine, cutting your costs and widening your profit margin: Big work area, full numerical control of spindle depth and tool changing as well as table positioning, 50 - 3000 rpm, 2000 lb. thrust, 10 seconds tool changing time, 16" stroke, fast positioning, ±.001" accuracy.

Get us started on a quote for you today. There's a Natco representative in your territory ready to talk business. Write for bulletin No. 157-2.

NATIONAL AUTOMATIC TOOL CO., INC.
Richmond, Indiana

NATCO

Changer arm rotates to bring new tool into position. While new tool is operating, tool presenter will index to receive old tool.



FIELD REPORT

Automated Line for Whirlpool

Whirlpool Division of Radio Corporation of America will shortly install a $700,000 automated line for production of food liners and freezer compartments at its Evansville, Ind, plant. Wallace Tool & Die Co of Indianapolis is scheduled to build the line.

Hoffman Forms Instruments Division

Hoffman Electronics Corp, Los Angeles, has formed a new Instruments Division to manufacture and market precision electro-mechanical equipment for industrial and defense applications. The division, which will headquarter in Los Angeles, is headed by Willian Van Dyke, formerly in charge of Douglas-El Segundo's Instrumentation Dept.

Packard Bell Gets Saturn Contract

Packard Bell Electronics has been awarded a $3-million prime contract by NASA for development, production and installation of an automated checkout system for the Saturn space vehicle booster.

New Plant for Illinois Tool

Illinois Tool Works has just completed construction on a new plant for its Conex Division at Des Plaines, Ill. The 76,000-sq-ft plant, which will manufacture plastic containers and packaging products, will begin operation February 1.

YB-70 Bomber Tooling Contract to Tool Research

Tool Research & Engineering Corp, Beverly Hills, Calif, has been awarded a $2.5 million subcontract for tooling the YB-70 Valkyrie bomber by North American Aviation. Tool Research will make special jigs and fixtures for sections and subassemblies.

New Welding Lab for Inco

International Nickel Co's Huntington (W Va) Alloy Products Division is now installing equipment in a 4000-sq-ft welding laboratory completed in December. The laboratory will concentrate on welding research for nuclear power plants. Included in the laboratory's equipment: a 300-kva industrial x-ray machine, a submerged-arc welder with two heads—for series arc or single-arc welding, an automatic gas-shielded consumable-electrode (MIG) welder, and a small electrode extrusion press.

Branch Plant for Universal Electric

Nearing completion at Ripley, Tenn, is a new 60-acre, 750,000 branch plant at Universal Electric Co, Owosso, Mich, for manufacture of fractional horsepower motors for use in pumps, appliances, air-conditioning and plumbing equipment.

More M-60 Tank Contracts Awarded in Michigan

Detroit Army Ordnance District announces additional awards to Michigan manufacturers for $16,627,516 worth of tank assembly and engine contracts for the M-60. Of this sum, upwards of $13 million has been awarded to Chrysler Corp, and the balance to Continental Motors. This brings total Michigan M-60 contracts to more than $94 million.

KPT Buys Kidde Tool

A newly formed company, KPT Manufacturing Co, has purchased Kidde Precision Tool Corp of Roseland, NJ. Joseph W Mollek, Jr, and John R Evans, formerly executive vice president and assistant treasurer of Walter Kidde & Co Inc, ex-parent company of Kidde Precision Tool, head up KPT. The new owners plan to expand the company's precision machining and welding operations, and to add a product line. •

"Now, son, you've got to learn to take it easy. I can't keep firing your bosses forever, you know."

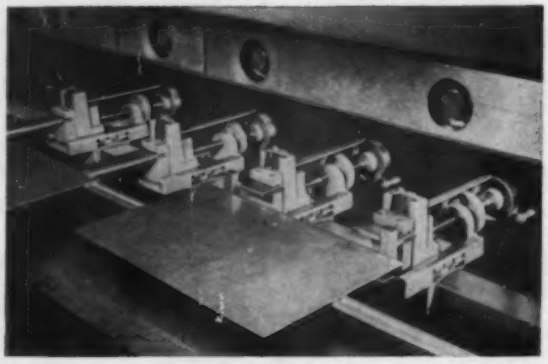
production drill for precision holes

Avey

Let us show you how to knock hours off your production and precision drilling with this MA-8. Capacity to ⅜". Eight spindle speeds with 10:1 range (variable speeds optional). Hand feed or air hydraulic. 12" swing. Column or bench type. One to six of our famous precision spindles, which give you quiet, vibrationless speeds up to 12,000 rpm. Send for Bulletin 857 or phone us. Avey, Box 1264, Cincinnati 1, Ohio.

CIRCLE 245 READER SERVICE CARD

NEW PRESS BRAKE GAUGE



Cuts Press Brake Setup Time 75%

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MACHINES AND ATTACHMENTS

1 NUMERICALLY CONTROLLED ENGINE LATHES—*R K LeBlond Machine Tool Co, Madison at Edwards Rd, Cincinnati 8, Ohio.* Illustrated bulletin, "Turn With Tape," describes company's Tape Turn lathes, heavy duty models with headstocks and carriages designed to accept commands from a GE Mark Century solid state numerical control system. These lathes can turn contours, tapers, sharp angles, and facing cuts all from tape. Six tools are carried in the numerically controlled tool turret, enough to perform all roughing and finishing operations on most jobs.

2 "FOSMATIC PRECISION BORING"—*Fosdick Machine Tool Co, 1633 Blue Rock Ave, Cincinnati 23, Ohio.* 19-page bulletin gives details on new Fosmatic jig borers, Models 44 and 54. These machines can be equipped with tape control in three axes, giving them full numerical depth control as well as positioning control. Fosmatic numerical control makes them highly useful for production line operations.

3 AUTOMATIC OBI PRESSES—*Niagara Machine & Tool Works, 683 Northland Ave, Buffalo 11, NY.* 6-page bulletin 54 illustrates and describes Series M line arranged for automatic, ultra-high speed operation with progressive dies. Included are standard specifications, die space dimensions and stroke shut height data for the complete line of 22, 35, 45, and 60-ton-capacity models.

4 30-IN. UPRIGHT DRILLING MACHINE—*Giddings & Lewis Machine Tool Co, Fond du Lac, Wis.* Bulletin BU-30 contains information on new 10-hp Bickford 30-in. unit with a radial drill type head. Machine is designed for production work with the regular table; a compound table is available for combination layout and production operations. Illustrations include closeups of compound table and centralized controls on head, showing large single dial for setting drilling and tapping depth. Specifications and optional equipment listed.

5 SINGLE SPINDLE CHUCKERS — *Warner & Swasey Co, 5701 Carnegie Ave, Cleveland 3, Ohio.* 32-page illustrated booklet presents application ideas for com-

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450* PIECES PER MINUTE!

NOT JUST SPEED ALONE ... BUT SPEED PLUS...

accuracy of product, rigidity, good tool life, fewer and simple adjustments, lower maintenance!

Have you witnessed production runs of difficult-to-make parts on National High Speed Headers? Observe the many features in machine and tooling. Start now to gain the benefits of sustained production at the highest safe speeds ever achieved!

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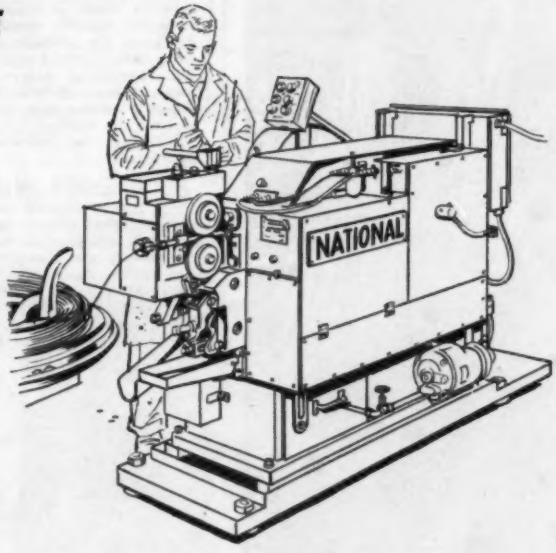

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27,000 Parts Per Hour*

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pany's line of chucking automatics. Including a large number of detail line drawings and photos, the booklet describes interesting machining jobs on 1AC, 2AC, and 3AC units in shops across the nation. Information on workpieces, tooling, machine functions, setup and methods is presented.

6 TURRET DRILLING MACHINES —*Motch & Merryweather Machinery Co, Avey Division, Box 1264, Cincinnati 1, Ohio.* 8-page bulletin 460 covers new Avey 6 and 8-spindle models. Details discussed include preselective speeds and feeds, automatic or tape controls, variety of table sizes, and a model with the turret mounted on a bridge or rail. Includes full specifications and dimensional drawings.

TOOLS AND ACCESSORIES

7 OPTICAL COMPARATORS — *Jones & Lamson Machine Co, Springfield, Vt.* 60-page book (Form 6013) contains complete catalog information. One section goes through a step-by-step, illustrated demonstration of how basic measuring is accomplished. Other sections of this completely indexed book provide details on accessories. Over 20 applications varying from tiny electronic components to large steam turbine blades are illustrated.

8 TOOLROOM GRINDING — *Macklin Co, Jackson, Mich.* 32-page booklet contains grinding and sharpening information. Explanatory data on grinding wheels includes description of wheel symbols and markings; factors governing toolroom wheel selection; types of bonds used; and wheel structure. Specific wheel recommendations are given for selection and use of wheels for grinding milling cutters; offhand grinding; sharpening reamers, hobs, broaches, twist drills, and cemented carbide tools. Separate section deals with gage grinding, as well as internal grinding, metal saw sharpening, and surface grinding applications.

9 MILLING CUTTERS — *Wesson Co, 1220 Woodward Heights Blvd, Ferndale 20, Mich.* 44-page catalog M-860 gives complete specifications on Wesson lines of throw-away and conventional carbide milling cutters, accessories, blades, parts, and tools. All types of cutters are illustrated. Rigidcut and Varicut inserted-blade cutters are described so that the best type of cutter for a particular application can be specified.

"Speak up, Powers! You don't have to treat me any different from anyone else who holds your future in the palm of his hand."

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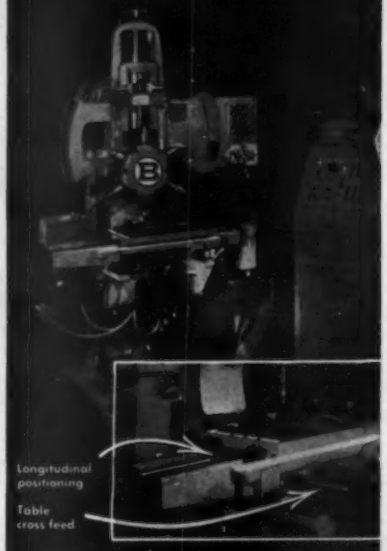
POSITIONING
TO ± .001"

RAPID
REPEATABILITY
TO ± .0005"



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DOES IT WITH
'BEAVERS'

Burg Tool Mfg. Co., Gardena, Cal., uses Beaver Ball Screws for obtaining this exceptional precision in their low priced, tape controlled, turret drilling, tapping, boring "Burgmaster Electropoint" and offer with it simplified operation with minimum maintenance.

Most all important machine tool builders use Beaver Ball Screws, particularly in their tape controlled models. We offer complete engineering information and assistance.

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CLAWSON, MICH.

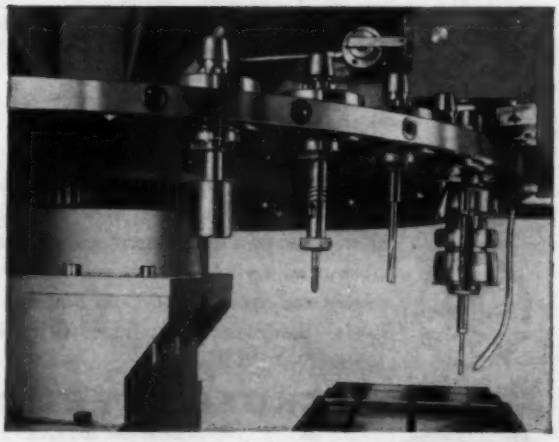
TOOL CHANGES IN SECONDS
BY NUMERICAL CONTROL

CLEEREMAN
SPINDLEMASTER

DRILLS, TAPS, BORES, REAMS, MILLS

Mechanical Tool Changing Controlled Completely by TAPE COMMAND

- Select any one of 30 tools.
- Position all three axes.
- Control speeds and feeds.
- Activate coolant cycle.
- Control type of operation.



The Cleereman Spindlemaster was designed from the start for Numerical Control and the Control was especially designed for this machine. It is the latest development in versatility in automatic operation on precision work.

Look into this new, cost-cutting opportunity by requesting full details.

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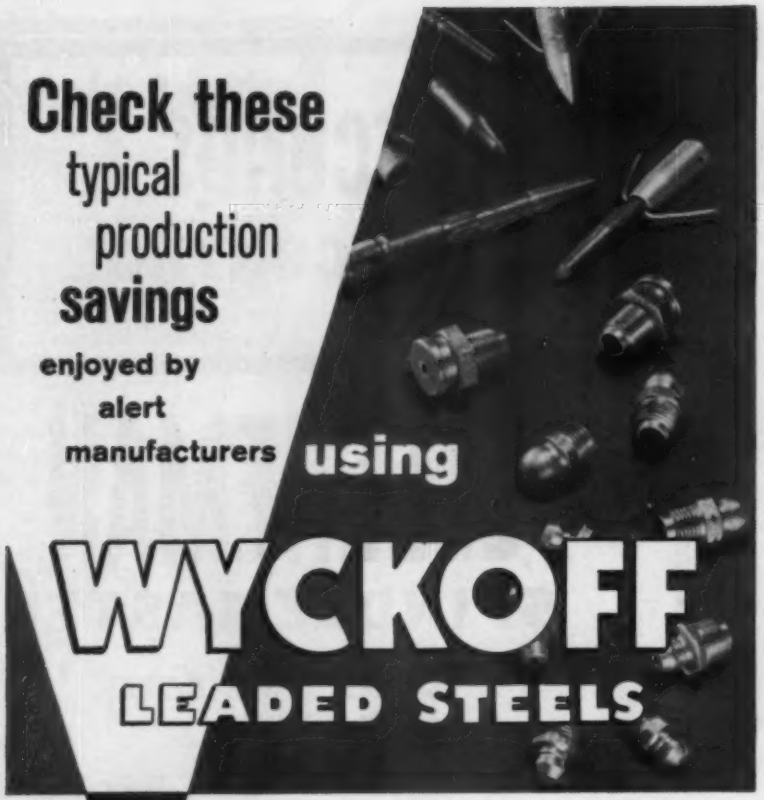

WYCKOFF LEADED STEELS

- Production economy without any sacrifice in quality
- Faster metal removal with fewer machining operations
- Turning, drilling, tapping, cut-off, reaming, threading, and other automatic operations are accomplished at much higher speeds and feeds
- Longer tool life, requiring fewer grinds thus reducing costly production line shutdowns

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All of these production advantages result in substantial savings in time and money when you specify and use Wyckoff Cold Finished Leaded Steels—the freest machining of all steels.

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CIRCLE 251 READER SERVICE CARD

Free Literature

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10 GAGE MODIFICATIONS — *Boice Gages Inc, Hyde Park, NY.* 84-page booklet entitled "Ideas" shows how standard Boice components can be incorporated in special and unusual gaging assemblies. Simple solutions to many common gaging problems are shown. Illustrations show special parts of the assemblies shaded, while stock components are without shading for easy differentiation.

11 MOUNTED WHEELS—*Bay State Abrasive Products Co, Westboro, Mass.* 30-page illustrated catalog simplifies customer specifications and ordering methods. More than 10,000,000 combinations of grit, size, bond, porosity, spindle size, and other features are possible to meet customer problems. Stock availability is included in the catalog. A new price sheet is available listing the majority of straight and tapered spindles; threaded spindles; and precision spindles.

12 CHIPBREAKER DRILLS — *Chicago Heights Steel Co, Speedicut Division, Chicago Heights, Ill.* 19-page catalog 168/11 provides detailed information on Speedicut Chipbreakers, design of which permit up to 50% higher feed rates than conventional drills. Rib throughout the full length of the flutes gives added rigidity to greatly increase the number of holes drilled per regrind. Web is constant through the entire length of the flutes enabling deep hole penetration, up to 10 to 12 times drill diameter, without withdrawal. The Chipbreaker drills all types of metals.

13 OPTICAL EQUIPMENT — *Edmund Scientific Co, Barrington, NJ.* 144-page catalog describes products such as measuring magnifiers, pocket comparators, illuminators, projection sets, and many other instruments and components for use in checking, measuring, and comparing.

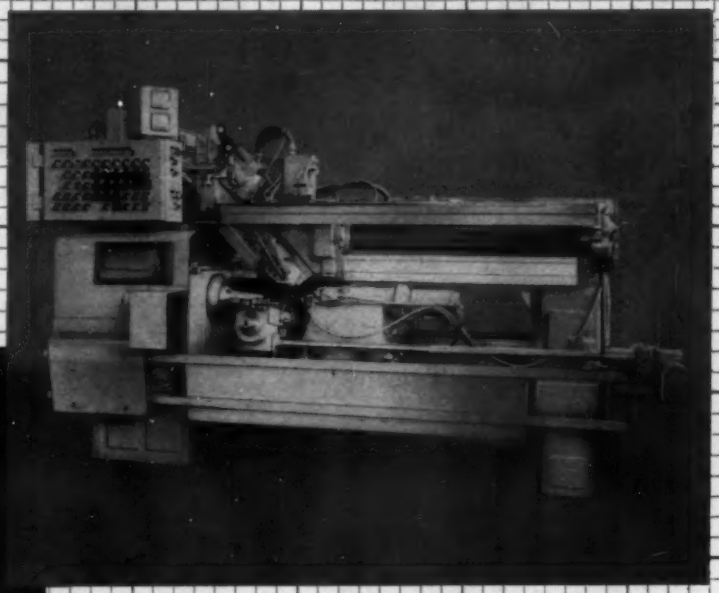
HEAT TREATING AND WELDING

14 ARC WELDING STAINLESS STEEL—*Lincoln Electric Co, Cleveland 17, Ohio.* 12-page bulletin 7300,2 provides information concerning techniques. Gives physical properties, structure, and welding characteristics of the different types of stainless steel. Chart lists deposit properties and electrode recommendation tables for the different types.

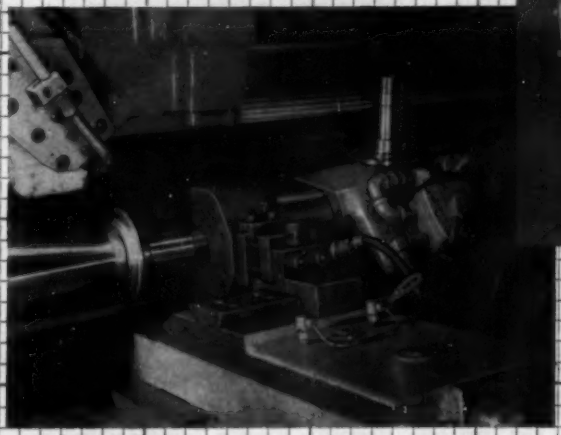
"He's really the fastest worker in the shop . . . can't wait to finish a job so that he can lay down again . . ."

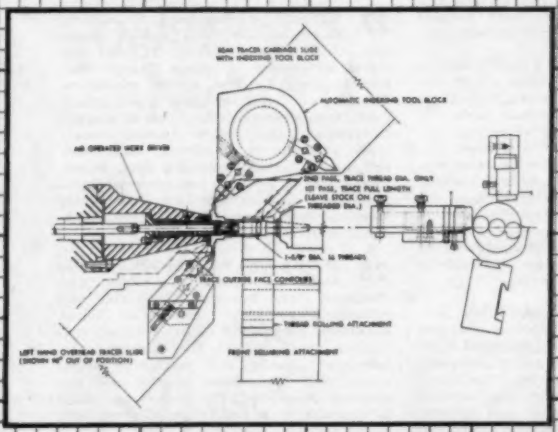
THREE OPERATIONS ONE HANDLING

MODEL LQ AUTOMATIC TRACER LATHE TURNS BOTH ENDS AND ROLLS THREADS ON FRONT WHEEL SPINDLES IN ONE CHUCKING



Below: Close-up View of Tooling




REAR TRACER CARRIAGE SLIDE WITH INDEXING TOOL BLOCK
AUTOMATIC INDEXING TOOL BLOCK
AIR OPERATED WORK DRIVER
ONE PASS, TRACE THREAD DIA. ONLY
1/2 PASS, TRACE FULL LENGTH (LEAVE STOCK ON THREADED DIA.)
1-1/8" DIA. 12 THREADS
TRACE OUTSIDE FACE CONTOURS
THREAD ROLLING ATTACHMENT
FRONT SQUARING ATTACHMENT
LEFT HAND OVERHEAD TRACER SLIDE (SHOWN 90° OUT OF POSITION)

Equipped with an auxiliary front slide and thread rolling attachment, this Seneca Falls Model "LQ" Automatic Tracer Lathe completes two turning operations and forms threads. The method of holding and driving the work piece on centers, as well as the two tracer carriages and the front squaring attachment which supports the thread rolling attachment, is shown in the tooling layout.

In operation, the left hand overhead tracer slide and the rear tracer slide operate simultaneously; the overhead carriage feeding towards the tailstock and the rear carriage feeding towards the headstock. The rear tracer slide is fitted with an indexing tool block which presents a separate tool for a qualifying cut over the threaded end on a short length second pass. Immediately following the second pass, the thread rolls advance to the center line of the work and then retract in rapid traverse.

The feed drive for the thread rolling operation is through a variable speed unit which controls the rate of feed as well as rapid traverse movements. The cycle is initiated automatically upon completion of the second pass over the threaded diameter. The front squaring cross slide attachment is operated by a barrel type cam revolving through 360°. The attachment may be adjusted along the bed in any location required to suit the thread on the work piece.

Investigate the versatility and many cost-cutting advantages of the Model LQ Tracer Lathe equipped with Seneca Falls Simplified Numerical Control.

Write for Bulletin Q-59

SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

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Gusher Pumps contain no seals, pre-lubricated heavy duty ball-bearings reduce maintenance to a minimum.

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. . . Gusher Pumps are precision built, there is no metal to metal contact within the pump.

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All of us at Ruthman are interested in your business. We want to earn it by giving you the best *service* at *all times*.

IN EFFICIENT OPERATION . . .

on your machine. Follow the leading machine tool builders; *specify* GUSHER Coolant Pumps.

WRITE TODAY FOR CATALOG

MODEL 11023 E

THE Ruthman MACHINERY CO.

1819 Reading Rd., Cincinnati 2, Ohio

Free Literature

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15 ATMOSPHERIC BURNERS—*Eclipse Fuel Engineering Co, Combustion Division, Rockford, Ill.* 14-page illustrated bulletin H-1 describes eight atmospheric gas-fired burners with maximum firing capacities from 10,000 to 2,750,000 Btu per hr. Provides dimensions, specifications, engineering data, and ordering information for pipe, wheel, immersion, ring, box, and U-type burners, atmospheric injectors and packaged burners. Includes an introduction to the operating principle, instructions for building atmospheric combustion systems, and an illustrated description of six typical installations.

16 ROLLER HEARTH FURNACES—*General Electric Co, Schenectady 5, NY.* 8-page bulletin GED-4304 provides details on gas or electric roller hearth furnaces for high production, economical annealing, hardening, brazing, sintering, and general heat treating. Design features of components of the furnaces are pictured and explained; different types of heating chambers are discussed. Diagrams show furnaces most suitable for each treating process and specifications chart gives application data.

17 "SOLDERING SIMPLIFIED" — *Kester Solder Co, Dept M3, 4201 W Wrightwood Ave, Chicago 39, Ill.* Newly revised instruction manual discusses basic principles and different types of solders and fluxes and their composition. Techniques, proper heat application, correct pre-soldering and post-soldering metal-treating procedures are covered in detail. Different types of equipment, correct use, and proper care are described and illustrated.

PLANT SERVICE EQUIPMENT

18 BLAST CLEANING BARRELS — *Pangborn Corp, Hagerstown, Md.* 16-page bulletin 705 covers five heavy-duty Rotoblast barrels with work capacities ranging from 15 to 102 cu ft. Features illustrated, specifications and overall dimensions outlined. Case histories picture and describe how these barrels have reduced costs substantially at different installations.

19 MAINTENANCE—*La Salle Steel Co, PO Box 6300-A, Chicago 80, Ill.* 16-page bulletin 24 presents helpful facts about making maintenance and repair parts, offers solutions for problems of getting machinery repaired and back into production quickly. Offers ideas on how to save time in machining parts, eliminate heat teating, quench cracks. Also offers suggestions for avoiding secondary operations. Included in the booklet are physical properties, chemistry, and tolerance for Stressproof steel bars, used in both production and maintenance, and parts applications.

20 POLISHING AND BUFFING MACHINES—*Packer Machine Co, 456 Center St, Meriden, Conn.* Illustrated booklet describes eight basic types of automatic units of the rotary indexing, continuous rotary, horizontal conveyor, and straight line conveyor type. Data on each includes the number of heads available, worktable or conveyor size, number of workholding spindles, production rate output, and the type of workpiece each machine is best suited to handle.

21 DUST COLLECTING EQUIPMENT —*Buell Engineering Co, 123 William St, New York 38, NY.* 4-page bulletin provides information on complete line of Buell-Norblo dust collecting, recovery, and classifying equipment. Applications include air pollution, material handling and classification, recovery of material from waste gases, and employee comfort.

22 PUSHBUTTON STATIONS — *General Electric Co, Schenectady 5, NY.* 8-page bulletin GEA-6544A discusses line for standard and heavy-duty applications. Includes photos of standard units and stations, diagrams showing dimensions, and ordering information. Photo with callouts explains features of typical heavy-duty station; applications shown.

PARTS AND MATERIALS

23 POSITIONERS—*Hanna Engineering Works, Dept PR-87, 1765 Elston Ave, Chicago 22, Ill.* 10-page bulletin 500A illustrates and describes how new electrical/mechanical Hanna-Powr positioners can be used to automatically position many types of mechanical devices regulating machine tools, valves, floats, doors, saws, hoppers, throttles, at any of several pre-determined positions corresponding to a remote control selector switch signal.

24 HOLDBACK CLUTCHES — *Formsprag Co, 23601 Hoover Rd, Warren, Mich.* 12-page catalog illustrates and describes clutches designed to prevent runback or reverse travel of inclined conveyors, bucket elevators, capstans, and related materials-handling or operation equipment. Clutches have torque capacities ranging from 1200 lb-ft to 136,500 lb-ft. Includes tables and charts covering speed and idler factors and engineering dimensional, and mounting data on 12 available models in bore sizes from 1-15/16 to 12 in.

25 PLASTICS—*Gisholt Plastics, Madison 10, Wis.* 8-page catalog (Form 1181-B) covers Gisholt Masterglas fiberglass reinforced custom molded plastics and new Delwood wood chip material molded plastics. Applications of Masterglas products range from small intricate parts held to close tolerances to large durable machine housings, automotive cabs and bodies. Mechanical and chemical characteristics listed.

26 ADJUSTABLE SPEED DRIVES—*Louis Allis Co, 427 E Stewart St, Milwaukee, Wis.* 6-page bulletin 2900 gives data on extensive line for applications in the ¾ to 2500-hp drive range. Describes four types of complete packaged drives and gives details on available ratings, speed ranges, type enclosures, associated controls, and many standard and special modifications.

27 RIVETS — *Townsend Co, Cherry Rivet Division, Box 2157-Z, Santa Ana, Calif.* 12-page bulletin TCL-160 discusses advantages of using Cherry commercial rivets for fast, secure, economical fastening in blind or open applications. Contains specifications for rivets in plugged (structural) and hollow (nonstructural) types available in aluminum, mild steel, and monel. Includes selection data, recommendations on drill hole size, material thickness guide, and an application tool guide covering three powered and three hand-actuated rivet setting guns.

28 ALUMINUM BAR STOCK—*Harvey Aluminum, 19200 S Western Ave, Torrance, Calif.* Brochure is a buying and estimating guide for deep-drawn hollow aluminum bar stock, available in all machining alloys. Tables give weights, precalculated cleanup and machining allowances, wall thicknesses, lengths, and mechanical properties. The hollow bar stock is available in a full range of sizes, both round and hex.

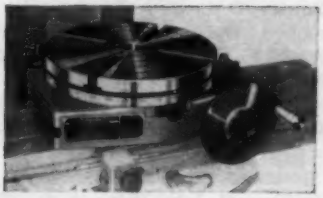
29 PLASTIC DIE STEELS—*Vanadium-Alloys Steel Co, Latrobe, Pa.* Brochure describes the properties and selection of plastic die steels. In order to show die makers how to match die steels to their particular jobs, the publication explains the grade characteristics of V-A's family of steels useful for plastic mold applications. Table of mold properties and simplified heat treating instruction facilitates die and mold steel selection. Photos illustrate applications of V-A steels for plastic dies and molds. ●

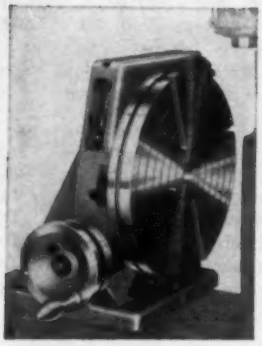
Bridgeport

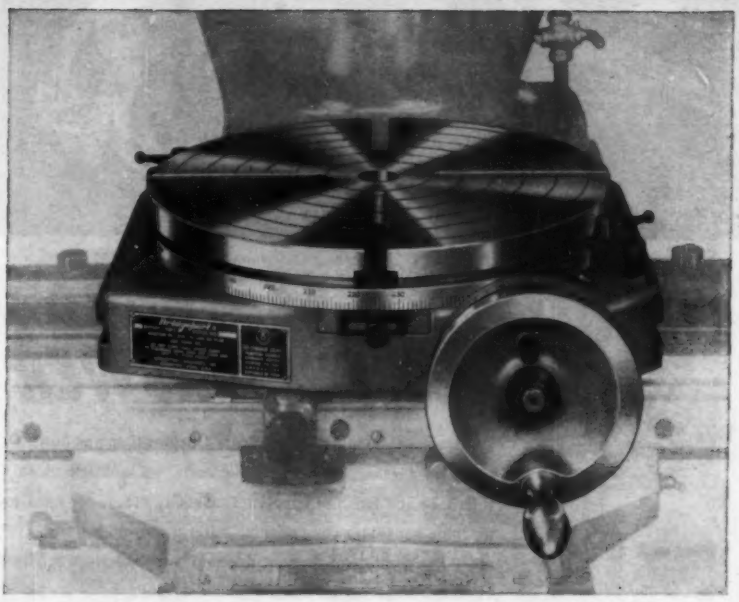
Precision

ROTARY TABLES

MODELS 12", 15" DIAMETER







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"The Most for the Least"

WORM and SHAFT	One piece — Hardened and Ground — Alloy Steel.
GEAR	Normalized cast iron fastened to table and machined to extremely close tolerances. Worm can be disengaged to facilitate set up. Adjustment has been provided for the following: worm end play, table radial play, table thrust, backlash of worm.
GRADUATIONS	Table graduated every degree, dial every minute, adjustable zero mark, adjustable dial.
BEARING	Anti-friction, adjustable roller bearing for radial play, adjusting thrust washer for end play.
LUBRICATION	Worm and gear immersed in heavy oil, oil cups for center bearing, table base surface, etc. Unit completely sealed against foreign matter.
LOCKING	Two non-influencing locks are provided.
ACCESSORIES	Tail stocks, centers, 90° angle plate, combination hold downs and handle clamps, indexing attachment and index plates.

Consult us or your nearest dealer for further details

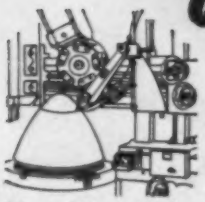
Bridgeport® MACHINES, INC.

Bridgeport, Connecticut

Manufacturers of High Speed Milling Attachments and Turret Milling Machines

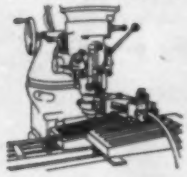
Machining beryllium with the MIMIK 9000 Tracer at The Beryllium Corporation's Hazelton, Pa., plant.

MIMIK® GIVES THE ANSWER



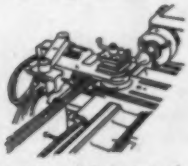
Vertical Turret Lathe

The question facing The Beryllium Corporation was how to speed production, cut high tooling costs and maintain close tolerance and finish in handling fast rising orders for hard-to-machine beryllium components. After a thorough study, aided by Mimik engineers, a decision was made to use Mimik Hydraulic Tracers on existing machine tools.



Milling Machine

The Mimik Tracer, because of its extreme accuracy, versatility and complete interchangeability, gave The Beryllium Corporation added production capacity at a fraction of the capital cost required to install new machinery.



Engine and Turret Lathes

Changing production demands are met easily with the Mimik Tracer. The complete unit can be transferred in a matter of minutes from machine to machine regardless of make. The hydraulic slide action and super-sensitive 360° stylus control ensures that fine tolerances are consistently achieved.

Call or write for more information on the Mimik Tracer for engine and turret lathes, V.T.L.'s and milling machines. Request details of Mimik's unique guarantee of time and performance related to a specific job and machine.

MIMIK® TRACERS

MIMIK TRACERS INC., Buffalo, N.Y.
EAST: Mimik Tracers Inc., 3901 Union Rd., Buffalo, N.Y.
CENTRAL: Bartsch Tool Corp., 3714 Oakton St., Skokie, Ill.
WEST COAST: Allied Pacific Manufacturing Co., Compton, Cal.
CANADA: Retor Developments Ltd., Galt, Ontario

Mimik-men are everywhere

NAMES IN THE NEWS

Harnishfeger Corp, Milwaukee, has named **Robert D Teece** vice president, engineering. Formerly assistant to the president, he succeeds **William S Burdick** who has resigned from that post to assume the position of corporate consulting engineer. **DeForest J Coyle** has been appointed plant manager of the Los Angeles manufacturing operations. He has been serving as manager of operations there.

Square D Co, Park Ridge, Ill, has named **Walter R Clarke** product manager in the marketing division. He has been serving as manager, systems planning, for the Industrial Controller Division in Milwaukee.

Shenango Furnace Co, has named **William H Johnson** technical director of the Centrifugal Casting Division, Dover, Ohio. Mr Johnson was formerly senior metallurgist, Process Metallurgy Division, at the Battelle Memorial Institute in Columbus, Ohio.

E W Bliss Co has appointed **Steve Stasko** chief metallurgist of the **Mackintosh - Hemphill Division**, Pittsburgh. He succeeds **Edward P Sandbach** who was recently promoted to manager of manufacturing operations.

McKiernan-Terry Corp, Harrison, NJ, has named **G Robert Compton Jr** executive vice president. He was formerly a vice president, heading the Pile Hammer Division. **Howard L Mattes** has been appointed vice president, engineering.

Rotor Tool Co, Cleveland, has named **Hugh L Whitehouse** a vice president and secretary. He will continue to serve as director of engineering.

AC Spark Plug Division of General Motors has appointed **Joseph K Decker** equipment sales manager. Mr Decker, who has been director of purchasing since 1955, succeeds **O F Frost**, recently named an assistant general sales manager at Buick Motor Division.

J Holland & Sons Inc, Brooklyn distributor of lines of machinery and supplies to the electroplating and metal finishing industries, has named **Louis Holland** president. **Abraham Polmar** has been elected vice president.

WANT TO SPEED FORMING OPERATIONS?

You specify the shapes...

ERIE WILL BUILD THE PRESS

When you have unusually shaped parts to position for assembling, forming, forcing, straightening and similar operations, an Erie C-frame hydraulic press may be the all-purpose machine you need. Open on three sides, the C-frame design provides maximum accessibility to the work area. It eliminates the restrictive caging normally caused by support rods or frame castings.

Custom-designed Erie C-frame hydraulic presses can be manufactured to meet unusual requirements. Both horizontal and vertical frame machines have been built for high-speed production in capacities to 500 tons.

Standard Erie C-frame hydraulic presses are also available in a range of sizes, with capacities up to 250 tons.

Erie C-frame hydraulic presses have all steel welded frames to assure a high safety factor with minimum deflection. Power units are built in. Sensitive controls include dual hand and foot levers to provide accurate operation in either direction.

For the complete story, phone or write Mr. Carl Hammon, Erie Foundry Company, Erie 1, Pa. Ask for Bulletin 370.

ERIE

ERIE FOUNDRY COMPANY

ONE OF THE GREAT NAMES IN FORGING SINCE 1895

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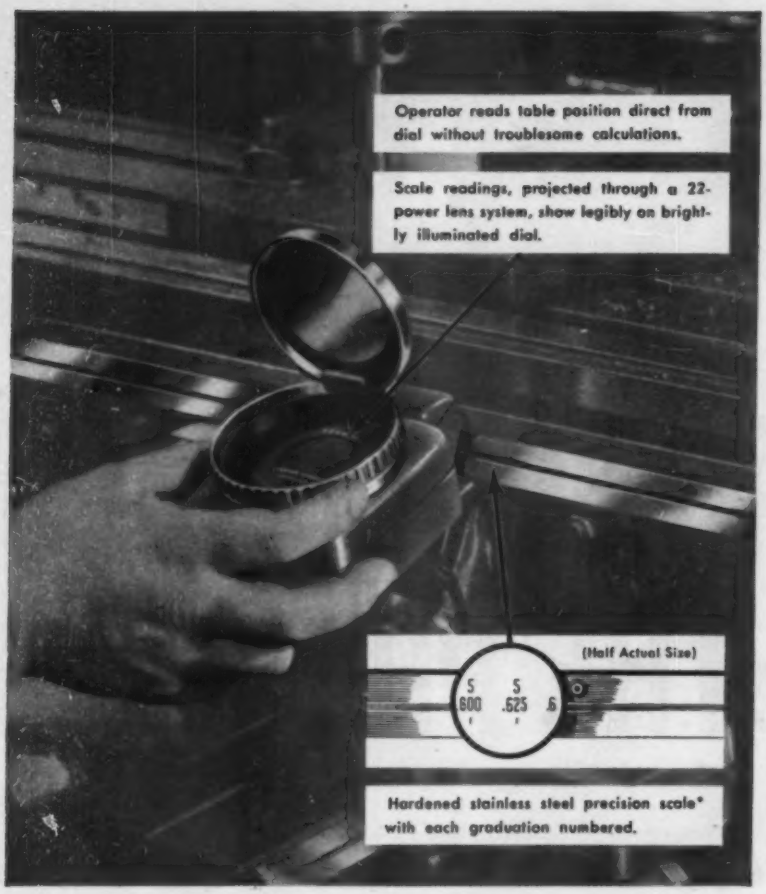
Manufacturers of Forging Hammers • Forging Presses • Hydraulic Presses • Trimming Presses

J-8083


Operator reads table position direct from dial without troublesome calculations.
Scale readings, projected through a 22-power lens system, show legibly on brightly illuminated dial.
(Half Actual Size)
Hardened stainless steel precision scale* with each graduation numbered.

New optical measuring instrument...

For precision work to .0002"

- No moving parts
- Easy to read and operate
- All readings on one dial
- Accuracy not affected by wear of table screws
- Eliminates gauge blocks, end rods

The new VERNAC direct reading optical measuring instrument indicates longitudinal, lateral or vertical position of the table of any machine tool without benefit of mechanical connections. It can be incorporated in new equipment or tools already in service.

HOW IT OPERATES: Readings from a precision scale, affixed to the machine tool table, are transmitted through a 22-power lens system onto an illuminated, highly visible, direct-reading dial. Readings are in .025" intervals. A double spiral reticle on the dial provides further measurement refinement to .0001". All readings are complete within the dial area eliminating reference to an outside pointer.

*The scale is a replica of a master certified by the U.S. National Bureau of Standards to .0001" maximum error over its entire length.

FREE BULLETIN will give you the details. Send for yours today.

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UNITED STATES AND FOREIGN PATENTS

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SIMPSON OPTICAL MANUFACTURING CO.
3202-06 Carroll Ave., Chicago 24, Ill.

Manufacturers and designers of precision optics for scientific equipment since 1926.

NAMES IN THE NEWS

Twin Coach Co, Buffalo, has named **George R Leonard** general sales manager. He was formerly manager of aircraft sales for the Dresser Manufacturing Division of Dresser Industries.

Big Joe Manufacturing Co, Wisconsin Dells, Wis, maker of hydraulic lift trucks, has appointed **Raymond J Jacklyn** manager of the new west coast branch located in San Francisco.

Crane Co has appointed **David McIntosh** vice president, sales, for **Chapman Valve Manufacturing Co,** Indian Orchard, Mass. The company was acquired by Crane in 1959. Mr McIntosh has been in charge of all manufacturing operations at the Chapman plant.

Pacific Car & Foundry Co, Seattle, Wash, has elected **Robert D O'Brien** president to succeed **Paul Pigott** who died Jan 23. Mr O'Brien was previously executive vice president.

Warner Electric Brake & Clutch Co, Beloit, Wis, has promoted **G R Harrod** from manager of industrial sales to general sales manager.

Permanent Mold Die Co, Hazel Park, Mich, has appointed **Leo Reierstad** general sales manager.

Diehl Manufacturing Co, Finderne, NJ, has appointed **Elwood R Zeek** vice president in charge of research and engineering. **James J Anderson** has been named vice president, marketing.

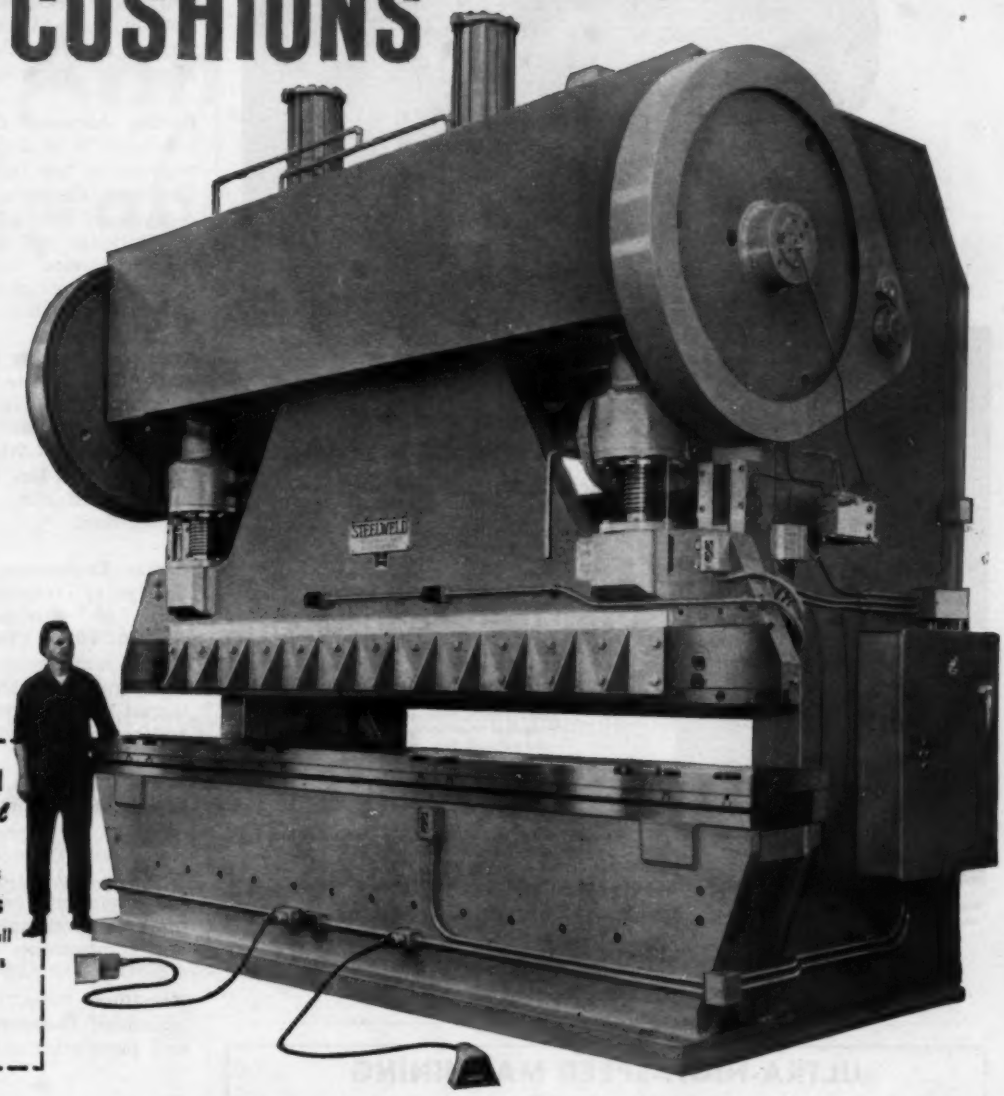
Mallory Metallurgical Co, Indianapolis, has appointed **John J Helvaty** purchasing agent. Formerly chief accountant, he succeeds **W J Topmiller** who has been named director of purchasing for the parent company, P R Mallory & Co.

Grove Valve & Regulator Co, Oakland, Calif, subsidiary of Walworth Co, has named **Kenneth F Williamson** vice president and product manager, valves.

Monroe Calculating Machine Co, a division of Litton Industries, Beverly Hills, Calif, has named **Franklin B Lincoln Jr** president. He succeeds **Fred R Sullivan** who has been appointed board chairman and chief

PRESS BRAKES with DIE CUSHIONS

This die-cushion-equipped mechanical Steelweld press brake has two speeds, 7 and 20 strokes per minute. Stroke length is 6 inches. Shut height is 20 inches.



Steelweld *Mechanical and Hydraulic* **Press Brakes** are available in all sizes to 2000 tons capacity for plate lengths to 30 feet.

Steelweld Press Brakes — mechanical or hydraulic — can be furnished with die cushions built in.

The brake illustrated was provided with twelve pneumatic die cushions assembled in a single line between the two bed plates. Each has a rating of four tons, or 48 tons total, when operated at 100 lbs. air pressure. Maximum capacity is 60 tons at 125 lbs. air pressure. Stroke of the cushions is adjustable from 0 to 3 inches.

The machine is rated 400 tons and will bend 12' x ½" mild steel between housings. Total length of bed and ram is 16'-0" including 10-inch extensions at both ends. The double plate bed is 20" wide. The ram has detachable brackets on either side. Throat depth is 18". Air-operated ram counterbalances are provided.

Control is air-electric with two foot stations for operation by one or two men. It includes "inch" and "run" with automatic stop at top of stroke. Ram adjustment is motorized. Back gauge has a range of 48 inches and rides on ball bearings. It is motor driven and front operated.

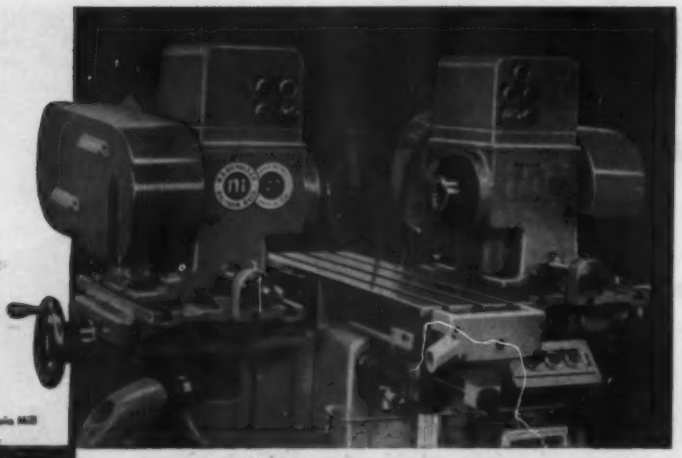
The design of Steelweld brakes simplifies the incorporation of die cushions and various features found helpful for metal forming operations. Therefore, it is possible to include at reasonable cost special features that will speed or aid unusual forming work.

Write for free booklet No. 2023

STEELWELD
Mechanical and Hydraulic
PRESS BRAKES

Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

STEELWELD MACHINERY DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 1480 E. 281 ST. • WICKLIFFE, OHIO



NICHOLS MILLERS . . .

Ideal Basic Machines for Automatic Production

NICHOLS MILLERS are versatile, work-devouring machine tools, unexcelled in accuracy and fine workmanship.

The TWIN MILL is practically TWO milling machines in ONE. Opposed Milling Heads have SIX-WAY adjustability for quick set-up and flexible approach to complex light milling operations. Push a button, and an automatic table cycle gives you TWO completed milling cuts. This unique duplex Miller is a cost-cutter without equal!

For high production precision milling where the double-barrelled approach of the TWIN MILL is not required, there are single spindle NICHOLS Semi-automatic Millers of varying work ranges. In addition to automatic table cycles, synchronized automatic down-feed of spindle head and automatic cross feeds are available.

NICHOLS MILLERS have a magnetic attraction for the Tool Engineer's ingenuity.

Write for literature and illustrations.

A NEW 16 mm. sound, color movie is available for free showing. May we reserve it for you?

Nichols 88A semi-automatic

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CAMS

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Over 100 Types of INDEXING TURNTABLES

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Contract production; Special automatic machines

CAM CALCULATING SERVICE

EISLER ENGINEERING CO., INC. | Charles Eisler Jr., President | 730 SOUTH 13TH STREET NEWARK 3, N. J. U.S.A.

executive officer of Monroe and a senior vice president of Litton. Mr Lincoln resigned as assistant secretary of defense at the close of the Eisenhower administration.

Boeing Airplane Co, Seattle, has appointed **W W Rutledge** operations manager of the Industrial Products Division. Formerly manufacturing manager of Boeing Wichita Division, Mr Rutledge will have direction of the production complex including manufacturing, quality control, facilities, and material.

Industrial Heating Equipment Association has elected **H J Pugsley** president. He is senior vice president of **Swindell-Dressler Corp,** Pittsburgh. **T H Wickwire III,** president of **Trent Inc,** Philadelphia, has been named vice president of the Association.

Hadco Engineering Corp, a subsidiary of Interstate Engineering Corp of Anaheim, Calif, has elected **Allan Fredhold** president. Hadco manufactures ground-handling equipment and is the West's largest manufacturer of trailer undercarriages and wheels.

Morse Chain Co, Ithaca, NY has named **Howard W Bennett** market manager. Mr Bennett has been associated with General Electric Co for 31 years and for the past 15 years has been both sales manager and marketing manager for gearmotors and transmission components.

Beryllium Corp, Reading, Pa, has appointed **Theodore R Blessing** general purchasing agent. •

"Actually, I'm in a very good mood, but I have to keep up appearances."

Announcement about

U. S. RUBBER COMPANY GRINDING WHEELS

By agreement with U. S. Rubber Company, the Manhattan Rubber Division has acquired and will now supply you with grinding wheels made with the same formulas, engineering, equipment and skill as formerly made by U. S. Rubber Co. This applies to abrasive wheels made with rubber or resin bonds.

You are assured of a continued source of the same quality wheels formerly supplied by U. S. Rubber Company.

ENGINEERED RUBBER PRODUCTS . . . MORE USE PER DOLLAR

RMTCO

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WRITE TO ABRASIVE WHEEL DEPARTMENT

MANHATTAN RUBBER DIVISION • PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

MEEHANITE® MEANS BETTER CASTINGS

Operation being performed is the reading of a scintillation counter interpreting radiation loss from a cobalt capsule located on the opposite side of this Meehanite shielding door casting for an Atomic Energy application.

Specify Meehanite® For High Density And Solidity In Heavy Sections

Dimensions of the 85,000 lb. Meehanite casting above are 12'6" x 12'6" x 12" thick. Specific gravity tests, ultrasonic and radiation loss readings verify its uniform and controlled density.

In massive castings of this type which have a slow cooling rate, there is a natural tendency towards a more open structure with a corresponding loss in strength. However, in Meehanite castings the effect of "mass influence" is minimized through the use of constitutional carbide controls which are exclusive to the Meehanite Process. Breakdown of structure due to slow cooling is avoided by providing a definite degree of undercooling of the graphite to the melt.

In specifying the correct type of Meehanite metal for castings with very heavy or very light sections, the effect of mass influence should always be considered.

For detailed information, send for a free copy of bulletin TD-14-EFFECT OF MASS INFLUENCE. Write: Meehanite Metal Corp., New Rochelle, N.Y.

MEEHANITE METAL

Meehanite Castings Are Made Only By Meehanite Foundries

NEW FILMS...

BREAKING THE DELEGATION BARRIER. *Produced by Roundtable Productions, 275 S Beverly Dr, Beverly Hills, Calif. 16 mm, sound, running time 30 min.*

The sixth in a series of supervisory development films, this unit is designed to develop an understanding of delegation, and what it can do to increase efficiency and promote personal growth at all levels of management. It is intended as a training aid in helping supervisors overcome their fear of delegating authority and responsibility to subordinates.

The film tells the story of a company faced with expansion and a rush contract. It shows how authority was delegated to three department heads and how each man almost fails to meet the contract deadline because of this fear of delegating work to his subordinates. In each case, the film shows how fear was overcome and how the process of delegation was able to benefit the company, the supervisors and the workers.

HERMAN SCHULTZ GOES TO THE 1960 MACHINE TOOL SHOW. *Produced by Kennametal Inc, Latrobe, Pa. 16mm, sound, color. Running time 40 min. Available through Kennametal district sales offices. No charge.*

Although the Machine Tool Show is now only a memory, many of its most interesting features are recaptured as the spectator watches Herman Schultz, a conservative old-timer who runs his own machine shop, gravely inspecting tape-controlled turret and tracer lathes, planers, and heavy-duty lathes being put through their paces with carbide tools.

INDUSTRIAL GASES AND SHIELDED ARC WELDING. *Produced by Air Reduction Sales Co, 150 E 42 St, New York 17, NY. 16mm, sound, color. Running time 27 min. No charge.*

Modern welding techniques involve more than just oxygen and acetylene; nitrogen, argon, hydrogen, and carbon dioxide all have a place, as this new film clearly brings out. The major part of its shows the uses of these gases in Heliweld, Aircospot, and Aircomatic welding, using ultra-

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POSITIVE-POWER VARIABLE

OR

5-SPEED DRIVES

15" and 20" SIZES

NEW . . . DIAL SPEEDS with VARIABLE DRILLS

20-inch.....150-2000 rpm
15-inch.....500-4500 rpm

5-SPEED DRILLS

20-inch.....150-2000 rpm
15-inch.....410-5380 rpm

- ***MACHINED and BALANCED PULLEYS***
- ***LUBRICATED FOR LIFE BEARINGS***
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- ***READY-TO-RUN with MOTOR & SWITCH INSTALLED***

Way ahead in EVERY comparison you could make. See for yourself. Write for literature today.

15" Variable Drive Bench Drill with ¾ HP motor, switch, ready-to-run . . . only $210.00. Order No. 1660.

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CLAUSING
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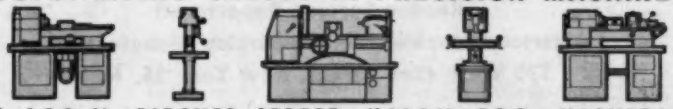
OUTSTANDING VALUES IN PRECISION MACHINES



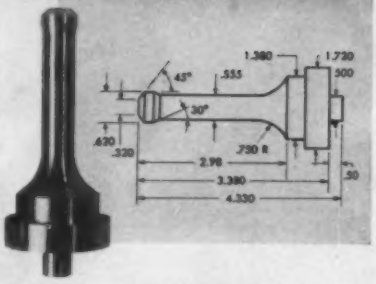
3-102 N. PITCHER STREET, KALAMAZOO, MICHIGAN

Contoured Stainless Valve Parts now produced at half the cost

Grinding Operation Eliminated
Hold #63 Microfinish

The Sturm Machine Co., Burbank, California, use a Mark II-A True-Trace attachment on a 15" Lathe to turn contoured 19-9 stainless steel pistons for hydraulic valves. This method has cut the entire cost of producing this part in half over former operations.

The True-Trace attachment has eliminated an extra grinding operation, formerly required to blend the radius—which had caused rejects. Now rejects are nil while consistently maintaining better than #63 microfinish and better than .001" tolerances. The template that guides the tracer stylus is made of flat stock, and cost $10.00.



19-9 Stainless Steel Pistons machined with the True-Trace attachment holding better than #63 Microfinish and less than .001" tolerances.

True-Trace supplies a complete range of pivot-type lathe tracer attachments which are complete self contained units, including hydraulic power supply.

Write for literature showing actual case histories of the wide range of applications of True-Trace attachments and the savings possible.

TRUE-TRACE CORPORATION

9830 Rush Street El Monte, California
CUmberland 3-4761

Manufacturer of 1, 2, & 3D tracer controls, attachments and components.

CIRCLE 264 READER SERVICE CARD

EXPLOSIVE FORMING . . . HOW IT WORKS, WHAT IT DOES

One of metalworking's newest and most exciting developments, explosive forming is explored in a comprehensive 12-page reprint from AM/MM. The article, priced at 35¢, giving complete picture on developments may be secured from

Reader Service Department
American Machinist/Metalworking Manufacturing
330 West 42nd Street, New York 36, N. Y.

NEW FILMS . . .

high-speed cameras to reproduce multiple high-speed welding and cutting operations. Also shown are examples of economical and automatic production in the automotive field on steel and aluminum.

HOW TO LOCATE FLAWS WITH DYE PENETRANTS. *Produced by Turco Products Inc, 24600S Main St, Wilmington, Calif. 16mm, sound, color. Running time 23 min. Available through local Turco representatives. No charge.*

Exactly how a dye penetrant works is clearly demonstrated by the use of glass micro-slides in this unique training film. Every aspect of the technique is demonstrated, from laboratory theory to mass production operation. Parts shown under inspection range from aircraft wing spars to pressure vessels, gears, and wheels.

MASS - PRODUCTION INSURANCE: the *Dependable Die Set. Produced by Producto Machine Co, 990 Housatonic Ave, Bridgeport 1, Conn. Filmstrip, 35mm, sound. Running time 15½ min. Available from Producto Machine or local representatives.*

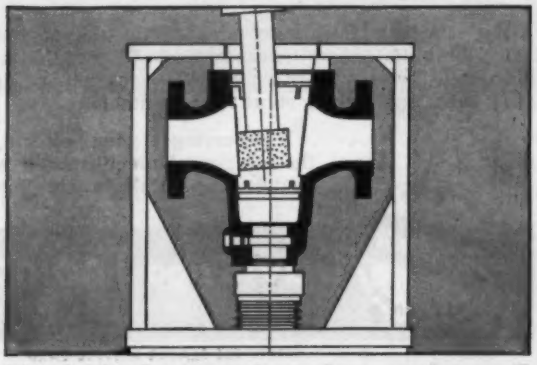
This new technical filmstrip shows how die sets serve the mass-production industries, and how the sets themselves are manufactured in the Producto plant. It is suitable for showing at technical society meetings, to apprentice and toolroom groups, and to vocational high school classes. It is presented by local Producto representatives who will discuss questions relating to die set manufacture and use after the showing of the film. •

"We'd like another round of wage increases."

Vertical grinding tapers profitably

Standard vertical grinder above is typical of those used by leading manufacturers of large valves for grinding internal taper seats. Profits are made because set up time is fast; for example, it takes about five minutes to change over from grinding 18″ valves to 10″ valves. The inherent rigidity of the machine is made doubly effective by gravity. Valve, fixture, and face plate are supported on a heavy *vertical* work spindle which promotes accuracy, precise concentricity, and extremely fine micro-inch finish.

SPRINGFIELD



Internal valve tapers, as shown above, are fast payoff jobs on a Springfield Vertical Universal Grinder. On this valve taper, stock removal is 0.020″ with a requirement for 85% blue or better on a taper gage. Surface finish is held well within the 30 RMS specified. Machine swings to 52″, grinding holes from 2″ to 42″ dia., 24″ deep in irregular or regular shaped work pieces.

Not limited to internal or exterior tapers, a Springfield grinds efficiently on O.D. and I.D. shoulders, offsets, undercuts, irregular holes, and mating angles—usually in one chucking.

A few production and toolroom men turn to a Springfield because there's no other way to do the job. Most turn to a Springfield because it's the most profitable way to do many jobs. Write today for Bulletin No. 197-D. The Springfield Machine Tool Company, Springfield, O.

DEBURRING··

No More Hand Filing, Brush or Wheel Removal of Burrs.

ROTO-MATIC Deburring Machines provide the fastest method of removing burrs from SPUR, HELICAL, WORM, HYPOID, BEVEL, SPIRAL BEVEL, SHAFT Gears, SPROCKETS and many irregular surfaces such as cams. Deburring is done at an average peripheral speed of 3 ft. per minute. By mounting the work pieces on a horizontal spindle in a vertical position and employing two floating grinding wheel units, gears are deburred on two sides after one revolution of the work carrying spindle.

Work rotation spindle is mounted on a tilt table so that bevel type gears can be angled anywhere within a range of 90 degrees. Protractors are provided to accurately indicate tilt of table, as well as locate grinding wheel spindles. Vertical position of grinding wheel spindles is adjustable to gear diameters.

With the adjustments provided set up time is reduced to a minimum. After the initial set up has been made the positioning can be charted for future use in the event of a rerun on the same part, further reducing operating time, and making short runs profitable.

If deburring is your problem, we believe we have the solution. Unit illustrated is only one of several models adaptable to a wide range of sizes.

Roto-Matic

Davis and Thompson Co.

4460 N. 124th ST. MILWAUKEE 18, WISCONSIN

CIRCLE 266 READER SERVICE CARD

IS INTERFEROMETRY THE ANSWER TO BETTER INSPECTION DEVICES?

The interferometer is playing an ever-growing role in industry's search for better inspection equipment. The latest thinking in this field—and how it can be used in the shop—is contained in a 16-page reprint from the June 13, 1960 issue of AM/MM. It's available for only 35¢ from

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330 West 42nd Street, New York 36, N. Y.

NEW BOOKS...

METAL CUTTING BIBLIOGRAPHY — 1943-1956 — *Published by American Society of Tool and Manufacturing Engineers, 10700 Puritan Ave, Detroit 38, Mich. 8½ x 11. Price $20.*

The original bibliography of metal cutting, prepared by Orlan W Boston, covered 4124 entries abstracting as many articles in chronological sequence from 1864 to 1943. In addition, it contained an author index and a subject index.

The present bibliography, prepared by the Research Information Service, John Crerar Library under the auspices of the ASTME Research Fund undertakes to bring this bibliography up-to-date. Since compiling the present volume took four years, this means up to 1956.

The flood of technical literature (and pseudo-technical literature) during this period made the task a monumental one. The 18,000 references compiled in the search were reduced to 5593 by rigidly limiting the scope and by tying together duplicate references.

In the extreme case of duplication, the SAE paper on the Hi-Jet system of cooling the cutting tools was reported in 25 magazine articles ranging from two days to ten months after delivery of the paper.

The abstracts are arranged in sequence of general subject and then cross indexed in a very thorough way. The index, in fact, takes up a substantial part of the volume and is well worth the space. There is also an author index.

It only remains to report that the quality of abstracting (judged by a check on a number of articles with which the reviewer was especially familiar) is unusually good.—AA

FBI REGISTER OF BRITISH MANUFACTURERS (33RD EDITION). *Published by Kelly's Directories Ltd and Iliffe & Sons Ltd, Dorset House, Stamford St, London SE 1, England. 1162 pages, 9½ x 7½. Price 50s ($7.00)*

Now listing nearly 8000 companies under 5400 headings, this old-established directory forms an ideal buyers' guide to virtually every type of product manufactured in Great Britain. It has the particular advantage of including a complete glossary in French, German, and Spanish, giving translations of every product

New Safety-Lock Tab • Improved Cup Shape Add Increased Protection and Comfort to AO Flexible Mask Goggles

Here are four improvements that make these new AO Vinylite Mask Goggles safer to use, more comfortable to wear:

1 New lock tab, with snap button, holds lens securely to frame at point of greatest stress, improves fit around entire frame. Lens will not pop out, but can be removed quickly and easily for cleaning or replacement.

2 New recessed slots at end of cup fit *over and around* temples of safety (or regular) glasses to keep entire cup edges in contact with face.

3 Increased eye cup depth gives additional coverage and protection at temples.

4 Improved flash around entire edge of mask molds to contours of face.

Lightweight, well-ventilated, extra-large face mask and .050" thick acetate lens assure the wearer of comfortable, optically correct, wide-angle vision while protecting entire eye area.

Your nearest AO Safety Products Representative now has this improved new model in impact goggles, chemical goggles, welding goggles, or chipping and grinding goggles, as well as two special models for maximum protection against chemical splash. Contact him today, or write for detailed folder, S-1229.

Your Surest Protection ... AO SURE-GUARD GOGGLES

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COMPANY

SAFETY PRODUCTS DIVISION • SOUTHBRIDGE, MASSACHUSETTS

Buck chuck on Gisholt CRI-DAN helps make amazing savings

Photos — Acme Industrial Co., Chicago

Smart production 467% faster!

The problem: a 20 NF Class 3 thread up to shoulder in bore on hex end of 440C stainless spool valve. Tapping was slow, breakage excessive . . . hardening shrunk and distorted threads . . . rejects as high as 20%.

The solution: A CRI-DAN lathe with a Buck compensating chuck, with internal pilot bushing, to center and grip work instantly for automatic taper threading with .4675" go —.4701" no-go precision. Result: 5.03 *minutes saved per part . . . no rejects.*

In your shop, too, you'll make money *every* time you chuck with Buck.

FREE catalog write —

Makers of Scroll, Power, Dust Proof, Independent Chucks.

BUCK TOOL COMPANY

310 SCHIPPERS LANE • KALAMAZOO, MICH.

CIRCLE 268 READER SERVICE CARD

DO YOU HAVE THE ENGINEER'S GUIDE TO BLIND RIVETING PRACTICES?

Installed cost of a blind rivet is ofttimes lower than over fastening devices. Here is a 8-page analysis and compendium of blind riveting practices and applications. The reprint is priced at 35¢ and may be secured from

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term used in the buyers' guide section, each being numbered for easy reference to the English headings.

Addresses are complete with telephone number and telegraphic code, outline of principal products, and parent company—where necessary. Also included is a list of British trade associations, brands and trade names, and registered trade marks.

ULTRASONICS AND ITS INDUSTRIAL APPLICATIONS—*By O I Babikov. Translated from the Russian and published by Consultants Bureau Enterprises, 227 W 17th St, New York 11. 224 pages. Price $9.75.*

Aside from political barriers, there is another important and difficult barrier between the US and Russia —language. This book is one of the first to be entirely translated—not merely extracted—from the Russian into English—at least in the technical metalworking field. As such it may mark a welcome trend that will improve state-of-the-art exchanges and indicate to US readers how well along the Russians are getting. It has been known for some time that many technical US books and magazines have been translated into Russian.

This is a pretty fair textbook, in spite of the stilted language that must be expected from a translation. There are a reasonable number of illustrations, including sketches, though the photos seem a bit washed out.

The chapter headings indicate that the book covers the subject as fully as possible—especially in a fairly modest number of pages. The general theory of ultrasonics is followed by material on how the vibration is generated, pulsing, flaw detection, inspection, machining, soldering and plating, then cleaning and metallurgical effects—the final chapter on how metal structure can be improved with ultrasonic treatment.

Comparing this and a current US book on ultrasonics shows that the state of the art is about the same in the two countries. The only major difference between the two books, aside from the obvious, is that the US text tends to be more specific, the Russian a bit more theoretical—though part of this is due to the fact that the domestic book is much longer and has more illustrations. —*CDE* •

Atrax

Precision Ground

SOLID CARBIDE TOOLS AND BURS

HOW TO BECOME AN EXPERT IN SOLID CARBIDE BUR SELECTION

Solid carbide burs are universal roughing and finishing tools. Atrax, manufacturing the most complete line, can furnish a size and shape to accomplish practically any metal removal or finishing operation.

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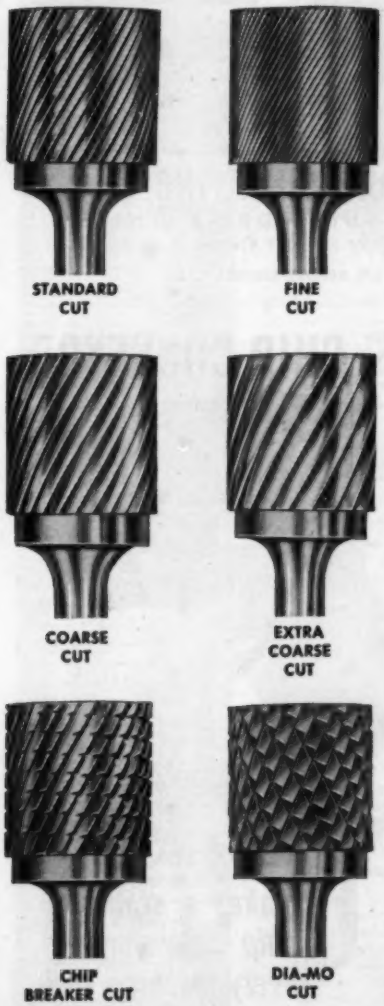

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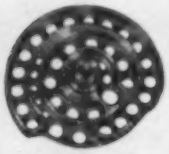

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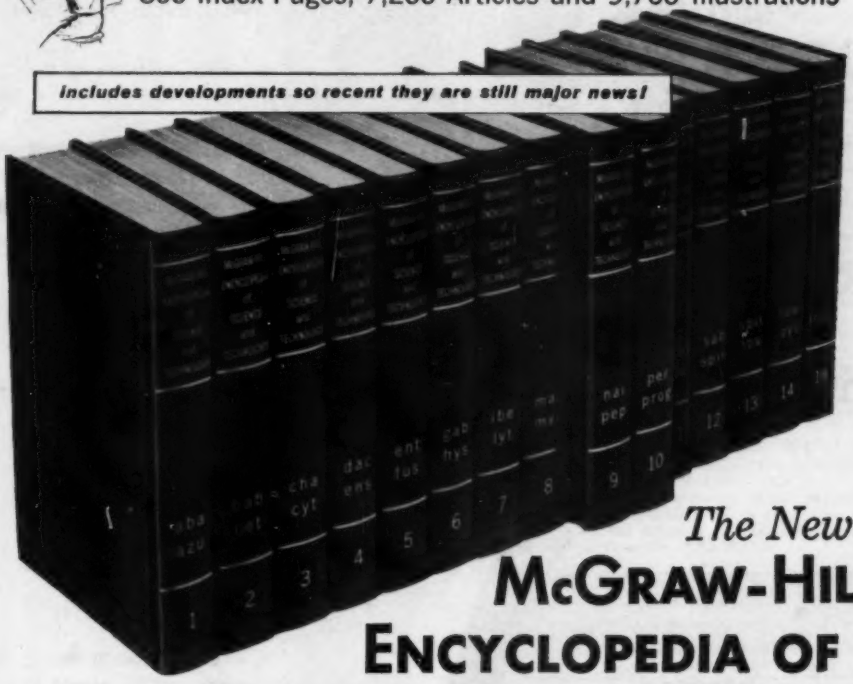

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7. Boring
11. Chucking Machines
12. Compressors
17. Drilling & Reaming Machines
19. Engraving Machines
20. Fabricating Equipment
26. Grinding Machines
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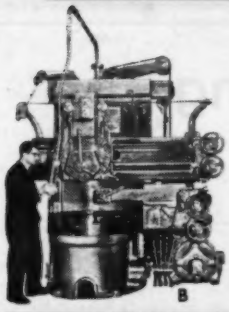

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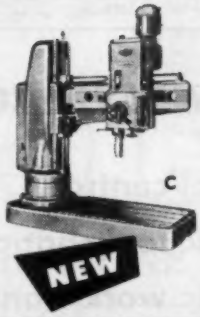

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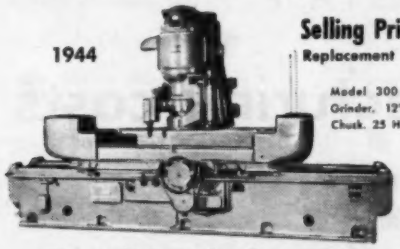

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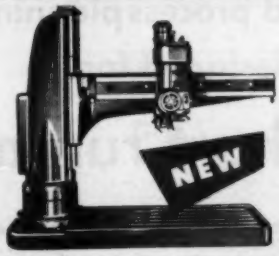

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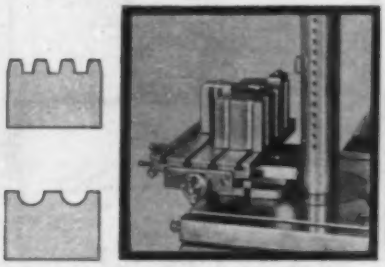

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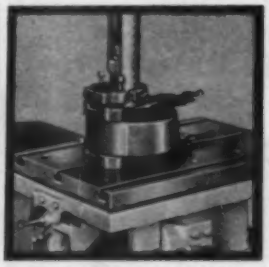

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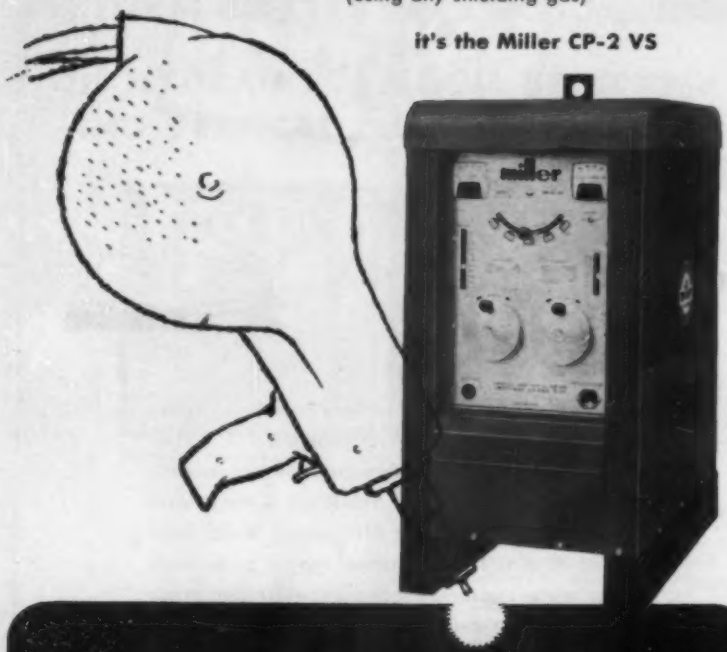

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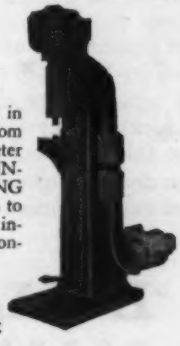

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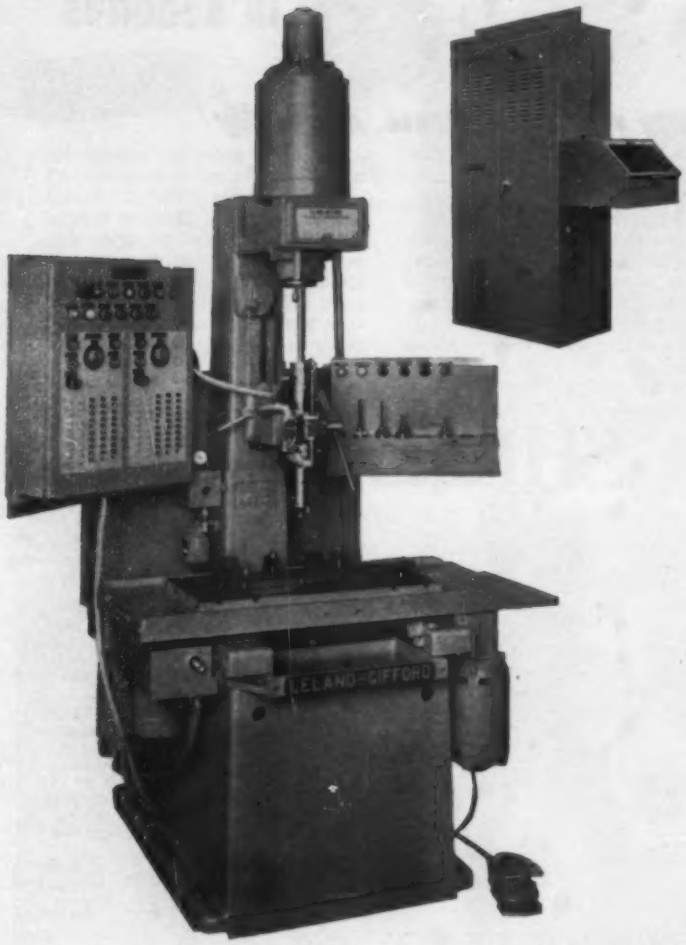
For General Purpose or Production Drilling



This sensibly simplified, sophisticated layout drilling machine combines the best features of the proven Leland-Gifford HOLE LOCATOR and the universally accepted G. E. Mark II numerical positioning control.

For single part operation, simply punch the keyboard or dial coordinates on the console. For repetitive work, use standard eight channel punched tape. Program can include automatic reversal for tapping and instant stops for tool and speed changes as indicated by flash tool change lights.

Rugged table has precision machined locating blocks, tee slots and locating keyways which extend the work capacity beyond the table traverse.

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- Uses standard eight channel punched tape for production drilling.
- Single part operation by keyboard or dialing coordinates on console.
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- High speed positioning by self-contained, closed loop, hydraulic circuits and reversible G. E. Thy-Mo-Trol controlled motor driven pump.
- Highly accurate, sensitive precision ball-bearing spindle incorporates a zero float, quick change chuck.
- Six station turret depth stop plus 5" traverse hand feed.
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Table positioning speed	200" per minute
Positioning accuracy	±.001" non-accumulative
Repeatability	±.0005"
Table size	W.S. 28" x 14"
Table travel	11" front to back x 15" left to right
Spindle overhang	13"
Spindle nose to table	17" Maximum 3" Minimum
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Floor space	Machine 60" x 50" Control cabinet 62" x 47"

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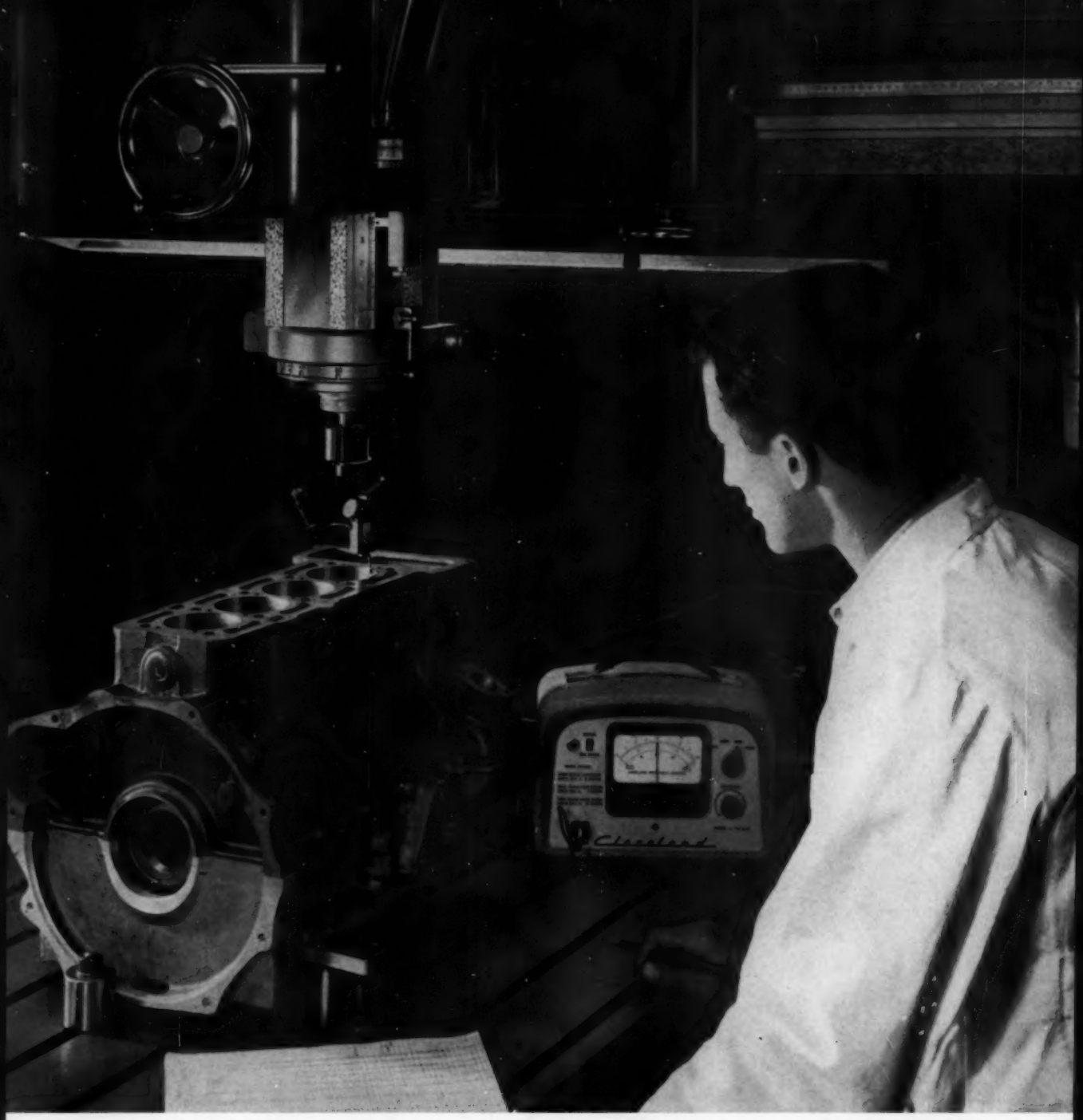

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